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THE OTTAWA NATURALIST.

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COLOURLESS BLOOD IN ANIMALS.

By PROF. E. E. PRINCE, B.A., F.L.S., &c., Dominion Commissioner of Fisheries, Ottawa.

We are so accustomed to think of that wonderful fluid, which circulates through the blood-vessels of animals, as essentially a red fluid, that it may be a matter of surprise to many that red blood is in reality very exceptional in the animal kingdom. In all the various classes of animals, from the lowest to the highest, we recognize the remarkable fact that colourless blood is most general. In the highest forms there are corpuscles, coloured by that oxygen-loving substance, red hæmoglobin; but the presence of this coloured matter is so uncommon in the blood of the lower types, that examples of it are of extreme physiological interest. Thus, the earthworm and the leech have red blood; but the presence of the red colour is not in the corpuscles, it is due to hæmoglobin in the serum or fluid. The fluid is red, but the corpuscles themselves, are colourless. Other worms (marine annelids) have emerald green blood, others yellow: but in most the fluid is destitute of colour. It is the same amongst insects, and arthropods generally. The heart, which passes down the back in these creatures, drives a clear corpusculated fluid over the body. Remarkable exceptions amongst these may be noted, however. Thus, a small Dipteran fly, *Chironomus*, in its aquatic larval condition, is of a brilliant vermilion hue, due to the red blood visible through the transparent walls of the worm-like body. Such exceptions only emphasize the fact more strongly that colourless blood prevails. Anyone who has studied the anatomy of a starfish, has noticed below the intricate water vascular system, a central ring or blood vessel encircling the mouth. This blood-ring is clear and transparent: and sends off a translucent radial blood vessel to each arm. The fluid

inside these tubes is colourless, slightly opalescent, and contains the characteristic corpuscles or floating cells present in all blood. This description of the nutrient fluid applies not to Echinoderms only, it is true, also, of mollusks, though there are some familiar exceptions. Certain cuttlefishes have green or even violet blood, while in the familiar *Planorbis* the blood is red. If from the simple dilated heart-tube of a shell-fish, say *Unio*, or of a beetle or lobster, we take a little of the watery blood, we may see, in the oxidised fluid, a faint blue tinge visible, due to haemocyanin, which tinge disappears under deoxidation. When we come to the vertebrates, the highest forms of animal life, we find in the simplest and most primitive of them,the worm-like lancelet (*Amphioxus*), colourless blood. Nay, in the early larval stages of other vertebrates, such as fishes, the blood is at first colourless, and the corpuscles exhibit no tint. Now it is well known that fishes, amphibians, reptiles, and higher animals, possess a circulation, called the lymphatic system, in which a clear corpusculated fluid flows. This lymphatic system is sufficiently distinct from the arteries and veins to be regarded as separate; but its real importance has not been generally recognised. It is usually regarded as a supplementary and subordinate system. In view of the foregoing facts it would seem in reality that the lymphatic system represents the primary blood-circulation. Physiologists have long been puzzled in interpreting the real nature of the red blood in man. The red-corpuscles are certainly not true cells, as Dr. Minot has shown, and they are not nucleated. The serum of red blood is almost identical with the lymph,and the white corpuscles are believed to be neither more nor less than lymph corpuscles or leucocytes originating in the lymphatic glands. The red-blood system has thus overshadowed the colourless blood, or lymphatic system, in man and the highest vertebrates, and the latter system has been, to some extent, turned to other purposes; the lymphatics of the digestive canal being now lacteals for conveying chyle into the red-blood system.

In the lower vertebrates the lymphatics still play an important part, and retain much of their primitive character. In fishes, well marked pulsating chambers or lymph hearts, connected with an elaborate system of capillaries and larger vessels, convey clear lymph fluid and floating

corpuscles. The lymph hearts occur in the tail region and are much more than mere ill-defined spaces in the tissues. They are distinct chambers with special walls, in which striated muscle fibres may be made out. A long lymphatic vessel passes midway along the lateral muscle masses receiving successive side branches, while two trunks run alongside the lateral nerves, one on each side, and two pass along inside the spinal canal. Perhaps the amphibians, frogs especially, have this colourless blood-circulation best developed. Two definite lymph hearts occur, in the frog, between the short rib-like transverse processes of the 3rd and 4th vertebræ, and a second pair behind the hip-joint, on each side of the urostyle. These pulsating organs show striped muscle fibres. Other large lymph spaces, which do not however pulsate, occur on each side of the head, and a chain of irregular spaces, filled with fluid, run down each side of the back, with corresponding ventral vessels, and ramifications along the limbs. Lymph spaces and vessels have not been noticed so prominently in reptiles, except in tortoises and crocodiles. In the latter there are large abdominal spaces, and smaller chambers near the root of the tail. In the tail region in birds, during the early stages especially, there exist well-marked lymph spaces. The existence of a lymph or colourless blood circulation in so many groups of animals, including the highest vertebrates, must have some weighty significance. Its primitive character is demonstrated by the fact that the suspended corpuscles are nucleated cells, and quite unlike the red corpuscles of warm-blooded mammals. When we thus find in the lowest vertebrate (*Amphioxus*) and in the early stages of higher forms, such as larval fishes, that the red blood circulation is absent there is every evidence that a colourless blood system is the original system, and that red-blood is a modified and secondary arrangement.

The blood circulation in the invertebrates is then a primitive system, which persists in *Amphioxus* as the only system; while in fishes and the lower vertebrates it maintains an importance almost equal to that of the red-blood circulation, but in the higher vertebrates, although it still supplies colourless corpuscles and serum to the red blood, the latter circulation has largely supplanted it and deprived it of its original importance.

THE RENSSELAER GRIT PLATEAU.

By R. W. ELLS, LL.D., F.R.S.C., F.G.S.A.

A very interesting report has recently been published by Mr. T. Nelson Dale, of the U.S. Geological Survey, styled "The Rensselaer Grit Plateau in New York." His paper is of interest to Canadian geologists since the rocks there discussed form part of the series so carefully studied in the earlier years of the Canadian Survey by Sir William Logan and his assistants in the province of Quebec, and the adjoining states to the south and described by him under the heading of "The Quebec Group." The area reported on by Mr. Dale was also examined very thoroughly by Sir William Logan, some thirty years ago, and his note books shew many careful measurements and sections of the rock there found which are evidently the extension southward down the valley of the Hudson, of the great series in Quebec which extends continuously from the extremity of the Gaspé Peninsula to the Vermont boundary. The arrangement and description of the strata as given by Mr. Dale, show that the same features are there found as in Quebec; and that the strata are practically the same in character.

These rocks in Canada consist of green, gray, black and red or purple slates, with heavy beds of gritty sandstones which occasionally pass into fine conglomerates. In the description of the grit and associated slates stated by Mr. Dale on p. 306 of his report, they are said to consist of a dark green exceedingly tough, in some places calcareous, generally thick bedded granular rock in which the quartz grains are apparent and upon closer inspection the feldspar grains also." "This rock is interbedded with strata of purplish or greenish slate (*phyllite*), varying in thickness from a few inches to perhaps a hundred feet . . . . the thin purple phyllite layers along the west edge of the plateau, contain minute branching annelid trails or fucoidal impressions." The conglomerate portion of the grits is thus described: "the pebbles of irregular outline measure from two-tenths to eight-tenths inch in diameter and consist of white, pinkish or blueish quartz, reddish felspar, gneiss, slate and red quartzite and as to relative abundance.

occurs in the order named."* These grits and conglomerates are now regarded by Mr. Dale as the equivalents of the Oneida conglomerates of Upper Silurian age.

The descriptions just quoted correspond so closely with those given by Sir Wm. Logan for the sandstone and slates of the Sillery formation as developed in Quebec and on the north-west coast of Newfoundland, that but little doubt can exist as to their being portions of the same geological series. The arrangement of strata at Rensselaer is evidently complicated by faults, folds and overturns as in Quebec which have been so extensive as in places to bring horizons, otherwise widely separated, contiguous to each other and in some cases even to have placed the newer formation beneath the older. Thus at Orleans Island, below Quebec, the strata which hold the Black-River-Trenton fauna, are now beneath those holding the Sillery-Lévis fauna, the whole series being apparently conformable. So also at several places along the coast below Métis the Trenton beds are enfolded and appear to constitute an integral part of the Sillery red and green slates. From the description of the rocks of the Rensselaer area a precisely similar arrangement would appear to exist and the Sillery red and green slates, grits and fine conglomerates appear to form a higher portion of the series above the "Hudson River" or Trenton formation. The relations of the several series in the two districts of Quebec and New York appear to be very similar.

It is therefore natural to suppose that the view taken by Sir Wm. Logan, after a careful study of the strata in both countries, that these represent portions of the same great series, is a correct one; and so strongly was he impressed with this fact that in the great geological map of Canada and the northern United States, (1866,) he so mapped them as portions of the Sillery and Lévis formations. It is interesting to note here also that in Quebec the conclusions first reached as to the stratigraphical sequence of this series coincided almost exactly with those put forth by Mr. Dale in his recent report, in which the Sillery and Lévis rocks were regarded as stratigraphically newer than the Hudson River

*The Rensselaer Grit Plateau in New York, by T. Nelson Dale, 13th Ann. Rep. U.S. Geol. Survey, pp. 306, 307.

division. Thus in a small volume called "Esquisse Géologique du Canada," published in connection with the Paris Exhibition, 1855, in the chapter relating to the rocks afterwards known as the "Quebec Group," after describing the Hudson River division near Quebec city and the overlying slates and conglomerates of Lévis, it is stated that "this formation at Quebec is succeeded by red and green slates with thin bands of calcareous matter, and intercalated towards the summit with great masses of quartzose sandstone, often calcareous, and coloured by a mixture of argillaceous matter which is greenish or reddish. This series of sandstones and slates which has a total thickness of 1000 metres has been named by Logan the Sillery group, and appears to be the equivalent of that which has been named by the New York geologists the Shawangunk or Oneida conglomerate, which in central New York lies between the Richelieu slates and the Medina sandstone."

Subsequently however the finding of Calciferous and Chazy fossils in the beds overlying the Hudson River portion led to a change of view as to the age of the Sillery and Lévis rocks, and to their being placed in a much lower position in the geological scale. The subsequent detailed work on these rocks shewed that the Sillery grits and slates were of the horizon of the Potsdam sandstone, while the Lévis limestones and slates associated, were Calciferous. As for the so-called Hudson River division, then supposed to be the lowest beds of the series, the work of Lapworth and Ami has shewn these to be presumably about the horizon of the Black River and Trenton.

It would thus appear that in connection with the Rensselaer beds the order as proposed by Mr. Dale, may be subject to criticism, more particularly when we consider the work done by Sir Wm. Logan in this area, and the resemblance, in every particular, to the beds which we call the Sillery and Lévis in Canada, and which the work of recent years has placed on a satisfactory basis. And it is interesting to note how the views of structure concerning the northern extension of these beds in Canada, abandoned forty years ago by Logan and his associates, have so lately been put forward by our fellow geologists south of the line. This may readily be regarded as a clear case of history repeating itself.

THE RELATION OF THE ATMOSPHERE TO AGRICULTURE.*

By FRANK T. SHUTT, M.A., F.I.C., Chief Chemist, Dominion Experimental Farm

The fundamental principle to realize in the consideration of this question is that plants are living organisms, and as such, in order to develop and multiply, require food. Their requirements may be ascertained by several methods, chief among which is chemical analysis, by which also we arrive at the proximate and ultimate composition of plant constituents.

A preliminary analysis of a plant, as for example the Indian Corn, enables us to arrange its constituents under one or another of the following classes:

WATER,
ORGANIC MATTER,
MINERAL MATTER or ASH.

Taking as an illustration the Indian Corn plant, when approaching maturity, we find that it is made up of,

WATER	72.0	lbs.
ORGANIC MATTER	26.6	"
MINERAL MATTER or ASH	1.4	"
	100.0	"

These materials have been derived and assimilated by the plant from two sources, the atmosphere and the soil.

With respect to the water contained in a plant, it is only necessary to point out that its source is soil-moisture, derived by the deposition of atmospheric aqueous vapour (chiefly rain), and that it has been taken up by the plant roots.

The mineral constituents are also soil-derived. To be assimilated they must be in solution, and to this end atmospheric agencies and small quantities of acid exuded by the plant rootlets, assist.

The organic matter of plants is composed of varying quantities of

*NOTE.—This is a condensed report of an address delivered before the Central Experimental Farm Club, March 27th, 1895.

the familiar substances, sugar, starch, fibre and a class of nitrogen-containing bodies known as albuminoids or proteids. Of these the gluten of wheat and other grains, forms a well known example.

The sugar, starch, fibre and other non-nitrogenous organic constituents are built up by the physiological functions of the plant from the carbonic acid, which exists to the extent of 4 volumes in 10,000 volumes of the atmosphere. This absorption and assimilation take place by means of the plant's chorophyll (or green colouring matter) in the presence of sunlight, oxygen by the same process being evolved. The carbon (the fundamental element in organic bodies) of the albuminoids is also derived from the same source. It will thus be seen that by far the greater part of the dry matter of all plants is derived directly from the atmosphere. It may be pointed out in passing that in this way the carbonic acid exhaled by animals is utilized, and thus the approximate constancy in the proportions of the atmospheric elements, maintained. The production and consumption of carbonic acid and oxygen thus effected, provides for the welfare of both plants and animals.

PLANT CONSTITUENTS.

The Organic elements	Carbon	Carbonic Acid	Starch	Albuminoids	Air derived elements
	Oxygen	Water	Sugar		
	Hydrogen		Fibre		
	Nitrogen		Oil		
The Inorganic elements	Calcium	Phosphorus			Soil derived elements.
	Magnesium	Silicon			
	Potassium	Sulphur			
	Sodium				
	Iron				
	Manganese				

Until recent years, it was believed that all plants absorbed their nitrogen from nitrogen-containing bodies (chiefly humus) in the soil, and from this source only. It has now, however, been definitely ascertained, as the result of many carefully conducted experiments in Germany and England, that certain plants have the power of utilizing the free nitrogen of the air, building it up within their tissues into complex organic substances, as the albuminoids. These plants are known as the Legumes, comprising the well known plants, pea, bean

clover, vetches, etc. The names of some of the principal scientists who have solved this problem are: Sir. J. H. Gilbert, who for more than half a century has been associated with Sir John B. Lawes in agricultural research, Wagner, Hellriegel, Willfarth, Frank and Warrington. Their successful work in determining beyond all doubt that the legumes have this power, marks the most important and valuable discovery in agricultural science of the present day. It means practically that the soil-nitrogen, exhausted by the growth of cereals and other farm crops, can be readily and cheaply restored by "green manuring" with one or other of the legumes—their nitrogen for the most part having been appropriated from the atmosphere.

The exact way in which these plants are able to appropriate free nitrogen is not known, but the fact has been ascertained that the assimilation is directly connected with the presence and development of certain tubercles or nodules on the roots. These tubercles contain micro-organisms, whose apparent function it is to absorb the atmospheric nitrogen, present in the interstices of the soil, and convert it into compounds of its host. We have here an excellent example of symbiosis, and one which must in the future prove of immense value to agriculturists and indirectly to the community in general.

THE ROYAL SOCIETY OF CANADA.

The fourteenth meeting of the Royal Society of Canada will be held in Ottawa on the 15th, 16th and 17th of May, 1895.

In a circular letter received from Dr. J. G. Bourinot, C.M.G., Hon. Secretary of the Royal Society, the members of the Ottawa Field Naturalists' Club are invited to contribute papers or articles for the approaching meeting of that Society.

Our President, Mr. F. T. Shutt, has been chosen by Council to represent us on that occasion. Any member of the Club desirous of submitting papers should communicate with him at as early a date as possible, so that the necessary arrangements may be made for their presentation before the proper section.

SIXTEENTH ANNUAL REPORT OF COUNCIL, 1894-95.

To the Members of the Ottawa Field Naturalists' Club :—

The Council elected by you on the 20th of March, 1894, has pleasure in reporting that the past year, on the whole, has been a successful and prosperous one.

Perhaps in no single year of the history of the club has the attendance at both the excursions or field days, in summer, and the evening soirées during the winter season, been so satisfactory.

The membership list keeps up a high level, there being no less than 233 at present on the roll. Seven new members were added during the year. Three members were removed by death, viz:—Mr. Scott Barlow, Chief Draughtsman and Cartographer to the Geological Survey of Canada, Mr. P. H. Le Rossignol, B.A.Sc., Assistant Chemist, Central Experimental Farm, and Mr. H. R. Moore, B.A. Seventeen members, many of whom are non-resident members, have sent in their resignations. Your Council has held ten meetings during the year to carry on the routine work of the club, which includes the 'striking' and arrangement of committees, the appointments of leaders in the various branches of the Club's work, and the nomination of the Editor of THE OTTAWA NATURALIST and his staff.

Early in the year, an effort was made by your Council to obtain a grant from the Ontario Legislature, but this proved unsuccessful. We are indebted to the Hon. E. H. Bronson for the manner in which he presented our claims before his colleagues in the Council.

The Royal Society of Canada's invitation to send a delegate to its meeting in Ottawa last May was received and Mr. F. T. Shutt, who has acted in that capacity for some years past was again chosen to represent us. At the meeting, he presented the customary annual account of the work of the club, which is incorporated in the Transactions of the Royal Society of Canada.

The Council finds it necessary to draw the particular attention of the members of the club to the necessity of paying the annual club dues promptly. There are now 114 members in arrears. The amount of the subscription is small and when not handed in spontaneously the time and labour involved in collecting the dues is very great.

Three successful excursions were held in 1894, under the auspices of the club.

1. *Chelsea.*—The first of these was to Chelsea, on the Gatineau Valley R.R., in May, when a number of Fellows of the Royal Society joined us as guests of the Club; 218 persons were present at this excursion which proved both enjoyable and profitable.

2. *Wakefield.*—This excursion was also largely attended. Some interesting work was done and valuable information obtained by members of the club.

3. *Galetta.*—The third excursion took place at this very interesting new locality for the club. The opening of the Ottawa, Arnprior & Parry Sound Railway has afforded special facilities to examine the region west of Ottawa and south of the Canadian Pacific Railway track.

Besides the large and general excursions of the club held at more or less lengthy intervals during the summer, a number of members have availed themselves of the sub-excursion scheme, which has always proved so important to the welfare of the club in this district. As a rule much better and closer work can be accomplished when a few members meet together and visit a certain definite locality with a special object in view. The Council recommends these sub-excursious to all the members of the club.

THE OTTAWA NATURALIST has been published by the Editor, Mr. W. H. Harrington. We regret, however, to add, that the January number was not issued, but if the increased interest taken during the past year in recording facts and observations in this district and elsewhere be an earnest of what the members of the club propose to do, then the success of the official organ of our club is assured for the future, and the NATURALIST will be filled with the records of observers in all parts of Canada since our membership counts most of the leading men interested in the scientific growth and development of our country. THE OTTAWA NATURALIST is not a purely local publication. A perusal of the volume of 162 pages, just published, amply shows the wide scope of its articles.

Our exchange list is an important one and the Library which the

Club possess is indicative of the high appreciation of the work done. From many quarters we hear of congratulatory remarks on our work and especially on our simple but practical methods of organizing for work.

Seven soirées were held during the past winter, which as you are all aware have been remarkably well attended and proved highly interesting.

The following is the programme as carried out by the Club during the past season, 1894-95.

PROGRAMME OF SOIRÉES.

Dec. 6th, 1894. MICROSCOPICAL SOIREE.

Inaugural Remarks, Dr. G. M. Dawson, F.R.S.; A Grain of Wheat, Prof. W. Saunders: Microscopic structures in young fishes, etc., Prof. E. E. Prince, B.A, F.L.S. Microscopes and slides were kindly furnished by Messrs. J. F. Whiteaves, Wm. Scott, G. M. Dawson, W. S. Odell, F. T. Shutt, A. Halkett, T. C. Weston, D. B. Dowling, W. Saunders, E. E. Prince, W. F. Ferrier, R. W. Ells and H. M. Ami.

Dec. 20th, 1894. GEOLOGY.

1. How Rocks are Formed, Dr. R. W. Ells, F.R.S.C. 2. Crystals. (Illustrated by Models), W. F. Ferrier, B.A.Sc. 3. Report of the Geological Branch, H. M. Ami. 4. On the Shumardia limestones of Levis, Que, T. C. Weston, F.G.S.A. 5. Description of a new Caddis-fly (*Phryganea ejecta*) from the Pleistocene clays of Green's Creek, Prof. S. H. Scudder.

Jan. 17th, 1895. BOTANY.

1. Flowering of Plants, Mr. R. B. Whyte. 2. The Growth and Development of Fruit, Mr. J. Craig.

Jan. 31st, 1895. CONCHOLOGY.

1. The present condition of Canadian Conchology, Rev. G. W. Taylor, F.R.S.C. 2. How Shells grow, F. R. Latchford, B.A. 3. How to collect Shells, Prof. J. Macoun, F.L.S. 4. Report of the Conchological Section, Mr. Fletcher.

Feb. 14th, 1895. ENTOMOLOGY

1. How Insects grow, Mr. James Fletcher, F.L.S. 2. Some

Insect Works, Mr. W. H. Harrington, F.R.S.C. 3. Report of the Entomological Branch, Mr. J. Fletcher. 4. Notice of a Monograph on Canadian Spiders by Emerton, H. M. Ami.

Feb. 28th, 1895. ZOOLOGY.

"On some protective peculiarities in young animals," Prof. E. E. Prince, B.A., F.L.S. Illustrated lecture.

March 14th, 1895. ORNITHOLOGY.

1. "Town Birds," Mr. W. A. D. Lees. 2. How to Study Bird-life, Prof. Macoun, M.A. 3. "Feathers," Mr. A. G. Kingston.

All these lectures were illustrated with microscopic sections or specimens and interesting discussions followed their delivery. Through the kindness of Dr. McCabe, Principal of the Normal School, Ottawa, the club has held its soirées in the lecture rooms of that institution. The thanks of the Council and Club are unanimously due to Dr. McCabe for his kindness and courtesy.

The Council in resigning its trust for the year, leaves the consideration of the future character of the work again in the hands of the members generally. It is possible that recommendations and suggestions may have occurred to many of the members, the adoption of which would add to the usefulness and still further popularize the work of the club. This meeting is the occasion upon which the future policy of the club should be fully considered.

All of which is respectfully submitted on behalf of the Council.

G. M. DAWSON,
President.

HENRY M. AMI,
Secretary.

Ottawa, 19th March, 1895.

OTTAWA FIELD-NATURALISTS' CLUB.

TREASURER'S STATEMENT, CLUB YEAR ENDING 10TH MARCH, 1895

RECEIPTS.

Balance on hand from 1893-94		$ 25 92	
Subscription fees received—			
Arrears of previous years	$ 48 00		
For current year	118 00		
For 1895-96, paid in advance	8 00		
		174 00	
Received for advertisements in "Naturalist"		37 00	
" "Naturalists" sold		2 20	
" "Authors' Extras" including arrears		17 25	
Net proceeds of excursions		7 10	
			$263 47

EXPENDITURE.

Printing "Ottawa Naturalist," Vol. VIII	$192 28	
Postage on same	15 93	
Printing "Authors' Extras"	11 30	
" *Flora Ottawaënsis*, balance to date	1 20	
General Printing and Stationery	13 92	
" Postage	4 66	
Expenses of Soirées	10 30	
	$249 59	
Balance on hand	13 88	
		$263 47

A. G. KINGSTON,
Treasurer.

Audited and found correct.
Ottawa East, 4th April, 1895.

WM. A. D. LEES, J. BALLANTYNE, } *Auditors.*

NOTES, REVIEWS, AND COMMENTS.

Geology.—ELLS, R. W., LL.D., F.R.S.C.—"*The Potsdam and Calciferous formations of Quebec and Eastern Ontario.*" Advance copy and Ex. Trans. Roy. Soc. Canada, Vol. XI., Section IV., pp. 21-30, 1895—(distributed, 12th February 1895.)

In this paper, the geographical distribution, local characters, palæontological as well as stratigraphical relations of the Potsdam and Calciferous formations as they are found in Eastern Canada in particular and in Eastern America in general are discussed. Dr. Ells points out also the relations of these two formations to the Levis and Upper Sillery. He correlates the Calciferous with the Levis of the vicinity of Quebec and the Potsdam with the Upper Sillery of the same region. He places all these in the Ordovician system—but refers the Lower Sillery to the Cambrian epoch.

Dr. Ells concludes by stating: "It would appear, therefore, from all the evidence at our disposal, that the real line of division between the Cambrian and the Cambro-Silurian system should be placed at the close of the Georgia slate and Red Sandrock divisions, and that the series from the base of the typical Potsdam to the summit of the Utica and Hudson River formations should constitute the system known as Cambro-Silurian or Ordovician.

AMI, H. M.—"*Notes on Canadian Fossil Bryozoa.*" Ex. Can. Rec. Science, Vol. VI., No. 4, pp. 222-229, Montreal, January, 1895.

This paper is practically a résumé of Prof. Ulrich's work on the Bryozoa of the Lower Silurian in Minnesota,* in which attention is called to thirty-three species from Canada comprising twenty-one genera. Six additional species of Bryozoa referable to as many genera are added to the above, but these were described by Prof. Ulrich's in Part II. of the Palæontology of Illinois, Section VI. The localities in Canada from which the species recorded were obtained, the horizon, references and other points of interest regarding these are given in them notes.

*Vol. III of Final Rep. Geol. and Nat. Hist. Survey of Minnesota, Minneapolis, 1894.

AMI, H. M.—"*Notes on a Collection of Silurian Fossils from Cape George, Antigonish Co., Nova Scotia, with descriptions of four new species,*" Ex. Proc. and Trans. Nova Scotian Inst. Science, Halifax, 2nd Ser. Vol. I., pt. 4, pp. 411-415, October, 1894.

Contains descriptions and notes on a collection of fossils made in Nova Scotia, by Messrs. Hugh Fletcher, and J. McDonald in 1880.

JONES, PROF. T. RUPERT F.R.S., F.G.S.—"*On some fossil Ostracoda from Canada.*"—Ex. Geol. Mag. Dec. IV. Vol. II, No. 367, pp. 20-28, Pt. II., January, 1895.

In this paper are described *six* new species of Ostracoda from collections made in the North West Territory of Canada and Manitoba. Three of these collections were made by Dr. G. M. Dawson, from the St. Mary River beds in 1874 and 1881:—Another collection was made by Mr. J. B. Tyrrell of the Geol. Surv. Dept. from the friable marl beds of the Rolling River district of Manitoba. The descriptions of the species by Prof. Jones comprise:

I. PLEISTOCENE of Rolling River, Manitoba.
1. Candona candida, Müller.
2. ? Ilyobates reptans, Baird.
3. Cytheridea Tyrrellii, n. sp.

II. ST. MARY-RIVER-SERIES. Milk R., N.W. T. (Loose.)
4. Pontocypris pyriformis, n. sp.
5. Cypris Dawsoni, n. sp.
6. Ilyocypris oblonga, n. sp.

III. ST. MARY-RIVER-SERIES. Milk River, N.W.T.
7. Cythere, sp. indet.
8. Candona ? Sanctæ-Mariae, n. sp.
9. Cytherella crucifera, n. sp.

IV. ST. MARY-RIVER-SERIES. Old Man R., N.W.T.
10. Candona ?, sp. undet.

Nine of these species are figured on Pl. II. accompanying the text Prof. Jones adds a note stating that the hingement being very rarely indicated, the generic relationships of the foregoing species are for the most part uncertain. This interesting contribution to our knowledge

of the more recent fossil Ostracoda of Canada, from the pen of Prof. T. Rupert Jones serves to increase our indebtedness to him for his zeal, patience and assiduity in working out the material which has been sent to him from Canada during the past thirty-six years.

Conchology.—RECENT MOLLUSCA FROM THE HEADWATERS OF THE OTTAWA. The following recent shells were collected by Mr. A. E. Barlow, of the Geological Survey Department. These have been kindly determined by Mr. Whiteaves of the same department, as follows :—

A.—FOOT OF LAKE TEMISCAMING.

Fresh Water Mollusca .

PELECYPODA.

1. Sphærium secure, Prime.
2. " striatinum, Lamarck.
3. " sulcatum, Lamarck.
4. Pisidium abditum, Haldeman.
5. Anodonta, sp.

GASTEROPODA.

6. Valvata sincera, Say.
7. " tricarinata, Say,
8. Amnicola porata, Say.
9. Physa heterostropha, Say.
10. Planorbis bicarinatus, Say.
11. " deflectus, Say.
12. " trivolvis, Say.
13. " " var. macrostomus, Whiteaves.
14. Limnæa desidiosa, Say.
15 " humilis, Say.

Land Mollusca.

16. Patula alternata, Say, sp.

B.—EMERALD LAKE.

From Emerald Lake at the head of the South Branch of the Opemican Creek, district of Nipissing, the following fresh-water shells were also obtained by Mr. Barlow, in a thick deposit of shell-marl :—

1. Sphærium sulcatum, Lamarck.
2. Planorbis trivolvis, Say, var. macrostomus, Whiteaves.

Ornithology. *Winter Birds.*—BOHEMIAN WAXWING (AMPELIS GARRULUS.) A flock of 20 or 30 of these rare cold weather visitors has been spending the winter with us. They first appeared on the 8th of January and since then have frequently been seen

in different parts of the city, feeding on the berries of the rowan-trees (*Pyrus Americana*). Their note is much like that of their summer cousins the cherry-birds, but louder and more incessant. Even during the worst days of the "cold wave," at the opening of February, their merry voices told how well earned was their old name of Bohemian Chatterer. The epithet *Bohemian* is probably applied with the meaning of *gipsy* in reference to their erratic migrations, for they have no special connection with Southern Germany. In winter they may appear at uncertain times in almost any country of the north temperate zone; and their summer home is in the extreme north, being bounded only by the last stretches of timber country. The few records of nests are from Lapland and Alaska

NORTHERN SHRIKE (LANIUS BOREALIS). This bird, always a sparse winter resident in the open country, has been growing noticeably commoner in Ottawa of late years. On a sunshiny winter morning his song from the top of poplar or maple is really pleasing, as well as a surprise from a bird of such hawklike build and habits. Perhaps he sings the praises of the introducer of the European sparrow, for, in the flocks of these birds, he seems to find a never-failing source of food.

A. G KINGSTON.

GEOLOGICAL SOCIETY OF AMERICA.

The winter meeting of the Geological Society of America was held at Baltimore, Md., Dec. 27th, 28th and 29th, and was largely attended by the Fellows. There were forty-eight papers on the list and most of these were read by the authors themselves. Prof. T. C. Chamberlin, of the University of Chicago presided. Dr. Adams, of McGill, and Dr. Ami, of the Geological Survey, were the only two Canadians present.

At the opening meeting, Prof. W. B. Clark, of Johns Hopkins University, read a biographical notice of the late Dr. G. H. Williams, of whose life and work a brief sketch has already appeared in THE NATURALIST.* Dr. Ami read an appropriate memorial of the late Amos Bowman, F.G.S.A. at one time a member of this club. Among the papers read at this meeting the following were prepared by

* OTTAWA NATURALIST, vol. VIII, No. 7, p. 113, 1894.

Canadians:—1. A further contribution to our knowledge of the Laurentian, Dr. F. D. ADAMS. 2. On the honeycombed limestones in the bottom of Lake Huron, DR. ROBERT BELL. 3. On some dykes containing "Huronite," ALFRED E. BARLOW. These three papers were read *in extenso* and were well received.

For a complete list of the papers read at the meeting the reader is referred to No. 1, Vol III, p. 99. of the "Journal of Geology," Chicago, Jan.-Feb., 1895.

EDITORIAL.

THE OTTAWA NATURALIST is entering upon the ninth year of its existence and as in the past, will be the official organ of the Ottawa Field Naturalists' Club.

The Council of the Club has appointed four of its number a Publishing Committee, and selected seven members of the club who are leaders in the various branches of the Club's work as ASSOCIATE EDITORS.

After careful consideration and discussion, the Publishing Committee of Council has decided to change somewhat the dress and general appearance of THE NATURALIST. The present number has been unavoidably delayed. It is the purpose of the new committee and editorial staff to issue THE NATURALIST promptly on time.

A number of advertisements have been secured from business firms and houses in the city. The attention of our members and others, in whose hands THE NATURALIST may fall is called to them.

Members and contributors will confer a favour on the Committee if they will send their articles on Geology, Botany, Entomology etc., at as early a date as possible. Records of observations, notes and papers on the Geology, Botany, Entomology, Zoology, Conchology and Ornithology of this district or of any part of the Dominion are earnestly solicited.

The intention of the Publishing Committee and of the editorial staff is to increase the sphere of usefulness of THE OTTAWA NATURALIST. Not less than 16 pp. will be published every month, and our purpose is to increase the amount of reading matter in proportion to the amount of MS. and funds at our disposal. With an increased revenue from an increasing membership, and from a larger number of paying advertisements, we hope to accomplish that purpose. We want new subscribers to our magazine and a much larger membership list to the club. The fee is very small, being only one dollar. Blank forms of application may be obtained from the secretary of the club from any member of Council, or from

THE EDITOR.

THE OTTAWA NATURALIST.

VOL. IX. OTTAWA, MAY, 1895. NO. 2.

ON SOME DYKES CONTAINING "HURONITE."

By ALFRED E. BARLOW, M.A.
Geological Survey Department, Ottawa, Canada.

(Read before the Geological Society of America, Baltimore, Dec. 28th, 1894.)

The name Huronite was long ago given by Dr. Thomson of Glasgow, to certain light-yellowish green masses or crystals which occurred porphyritically embedded in a boulder of diabase found on the shores of Drummond Island, Lake Huron, specimens of which had been sent to him by the late Dr. Holmes of Montreal. Thomson regarded it as a new species and published a description and analysis of it in his Mineralogy of 1836. The occurrence of these crystals was first noticed by Dr. Bigsby in 1820, who writes of the rock containing them in a general way as "greenstone porphyries having a light-colored base and containing crystals of red or white felspar--seldom of both in the same block,"(1) This brief and general description would not have been sufficient for purposes of identification except for the fact that his manuscript report which formed the basis of this paper, (2) was lately presented to the library of the Geological Survey of Canada. In the appendix Dr. Bigsby notes "among the debris of the shore of Lake Huron are porphyries of greenstone with embedded crystals of red felspar or of four or six sided prisms of cream white colour, foliate fracture, cleavage about 60, yielding to the knife readily, translucent at the edges and of a feel slightly soapy. Their crystallization is seldom well defined, but sometimes remarkably so." This clear and accurate description serves at

(1) Trans. Geol. Soc. London, Vol. 1, p. 205. On the Geography and Geology of Lake Huron, read Feb. 21, March 7 and 21, 1823.

(2) Notes on the Topography and Geological structure of the north-west portion of Lake Huron, addresseed officially to Dr. J. Wright, Inspector of Hospitals in Canada and dated Quebec, Feb. 23, 1821.

*(Commu icated by permission of the Director)

once to identify the substance composing these porphyritic crystals with the mineral described later by Dr. Thomson as "Huronite." The source of these boulders was not known and the mineral never found "in situ" until 1881, when Dr. Robert Bell, (1) of Ottawa, in his examination of the country to the north-east of Lake Superior, noticed the occurrence "of a dark grey crystalline diorite (in one place rendered porphyritic by spots of light-greenish yellow felspar) on the neck of land separating Lake Mattawagaming from Lake Wabatongwashene." This rather brief description was altogether inadequate to connect the mineral with the Huronite which had previously been described by Thomson, and it was not until Dr. Harrington, of Montreal, visited the spot on professional business some year later, that the true identity of these "spots" was clearly established. In 1891, Dr. Selwyn, of Ottawa, happened to be at the same locality which is situated between Missinaibi and Loch Alch Stations on the main line of the Canadian Pacific Railway, and he states that the dykes containing the Huronite cut both Huronian and Laurentian strata. During the construction of the Canadian Pacific Railway in 1884, Drs. Girdwood and Ruttan made a collection of the principal rocks met with on the main line from Chalk River westward. This collection, they subsequently presented to McGill University. Among the specimens, was one of a dark green diabase with phenocrysts of a mineral resembling Huronite scattered through it. This specimen had been obtained from a dyke cutting the granitoid gneisses a few miles north-west of Pogamasing Station. The microscopical examination, however, reveals the fact that the original Drummond Island boulder was not derived from either of these localities. Mr. W. G. Miller of the School of Mines, Kingston, who acted as Dr. Bell's Assistant in 1893, mentions the occurrence of a dyke containing Huronite near the contact between the granite and slates (Huronian) at Depot Lake in the northern part of the Township of Proctor, about fifteen miles north-east of Cook's Mills. From its geographical position and the direction of the glacial striae this would seem to be the most likely source of the Drummond Island boulder, although this cannot be ascertained with certainty as the specimen from the locality

(1) Report, Geological Survey, Canada, 1880-2, part c, p. 4.

was lost. Mr. H. G. Skill, of Cobourg, Ontario, who assisted the writer in 1891, discovered another dyke containing this mineral, about one quarter of a mile north of Murphy Lake, in Timber Limits 90, Algoma District. During the progress of his explorations in the peninsula of Labrador, Mr. A. P. Low, of the Geological Survey of Canada, noticed the presence of Huronite in a dyke cutting Laurentian gneisses about ten miles north of Lake Kawachagami on the portage route between the Rupert and Eastmain rivers and also in two dykes, each about two hundred yards wide, breaking through rocks of Cambrian age, on the west branch of the Hamilton River, fifteen and twenty miles respectively, below old Fort Nascawpee, on Lake Petitsikapow.

Dr. Harrington (private communication) has noticed loose pieces of diabase containing Huronite a few miles beyond Amyot Station. He also mentions the occurrence of a diabase dyke four inches in width, containing phenocrysts of the same mineral, a short distance east of the crossing of the Magpie River, near Otter Station, on the Canadian Pacific Railway.

Prof. N. H. Winchell, of Minneapolis, Minnesota, in his visit to the Lake Huron district, in 1889, made note of "the occurrence at Algoma of occasional very interesting boulders (1605). (1) They contain large and small rounded whitish green felspathic spots which are distributed somewhat like porphyritic crystals but they have not the regular periphery of crystals. They are in a matrix of ordinary diabase of dark green colour and the spots make the rock noticeable, their largest size being somewhat larger than an inch in diameter. Some of the boulders are put in the foundation of the great hotel which the Canadian Pacific Railroad (2) projected at Algoma, and that is where we saw them first. Dr. Selwyn recalled the dyke cutting the Animikie on the high ridge back of Silver Islet, as the only spot where such a rock is in place," Professor Winchell, who visited this place in 1879, has sent me a small chip from a specimen then collected, as well as fragments of the Algoma boulder

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(1) The number 1,605 refers to the number of the specimen in the rock series of the Geological Survey of Minnesota

(2) 18th Annual Report, Geological Survey, Minnesota, 1889, pp. 58 and 63.

and a small sample from a dyke near Gunflint Lake, north-west of Lake Superior. The phenocrysts of felspar in the Silver Islet specimen, according to Professor Winchell (1) are distinctly angular and not greenish, but greyish in colour. Under the microscope, these felspar phenocrysts are seen to be a plagioclase towards the basic end of the series (very probably labradorite) which has undergone only incipient alteration, whereas, in general the Huronite shows very great decomposition.

The writer has seen numerous boulders of diabase containing this mineral in the region to the north and north-east of Lake Huron, especially on the shores of Lake Huron from Killarney westward to the mouth of the Spanish River,

During the summer of 1893, the writer also noticed a boulder of dark green diabase, on the west shore of Bear Island on Lake Temagami, with plagioclase phenocrysts, which bore a very marked resemblance to the more altered Huronite. As the felspar seemed so fresh and glassy in places, it was thought an optical examination accompanied by a chemical analysis would throw a great deal of light on the original character and composition of Huronite. Dr. Harrington kindly undertook the analysis of this felspar, which proves it to be labradorite. Under the microscope most of these crystals are quite fresh, although certain portions are more or less clouded by the presence of decomposition products, which it is often difficult to resolve, even with the higher powers of the microscope. Certain of the crystals, however, show the same alteration, only in a lesser degree, as that which characterizes the Huronite.

It will thus be seen that the mineral is by no means so rare as some have supposed, but has, on the contrary, a wide geographical distribution. The sole reason of its not being discovered, "in situ," earlier seems to have been due to the necessarily hurried and imperfect explorations first undertaken through these wild and unsettled districts.

In 1885, Dr. B. J. Harrington, of McGill University, Montreal, decided to undertake an examination of the Pogamasing mineral for purposes of comparison with that contained in the original Drummond

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(1) No. 601, 10th Annual Report, Geological Survey, Minnesota, p. 56.

Island boulder, a sample of which was contained in the Holmes collection in the Peter Redpath Museum. In the course of this investigation he discovered some very grave errors in Thomson's description. "The hardness for example is about $5\frac{1}{2}$ instead of $3\frac{1}{4}$ as stated by Thomson. Instead of being infusible it is distinctly fusible (F about 5) while it contains alkalies the presence of which is entirely ignored by Thomson."(1)

Dana, in an old edition (2) of his mineralogy mentions Huronite under Prehnite, evidently deeming it an allied mineral. In 1889, (3) the same author mentions Huronite along with Weissite and Iberite as a supposed altered form of Iolite (Cordierite). In the same edition (4) he also says "Thomson's Huronite is an impure anorthite-like felspar related to bytownite, according to T. S. Hunt (priv. contrib.), excluding the 4·16 per cent of water the SiO_2 would be 47 per cent of the remainder." Again, in the same edition, Dana states (5) "Huronite, Thomson (Min., I., 384, 1836) considered an altered mineral near fahlunite by T. S. Hunt, occurs in spherical masses in hornblendic boulders in the vicinity of Lake Huron." In the last edition of Dana's Mineralogy (6) the author, Mr. E. S. Dana, places the mineral under anorthite on the authority of Dr. Harrington's paper in the Transactions of the Royal Society of Canada, but Dana is wrong in referring the analysis made by Mr. N. N. Evans, to the Huronite of the Drummond Island boulder, for in reality it belongs to the Huronite found by Dr. Girdwood near Pogamasing. Michel-Lévy and Lacroix (7) include Huronite among the decomposition products of Iolite or Cordierite. The failure to assign to Huronite its rightful mineralogical position arose from the fact that it was impossible to ascertain its true nature by chemical analysis. It remained for the microscope to disclose its composite nature and to show its relation to the more widely known "Saussurite."

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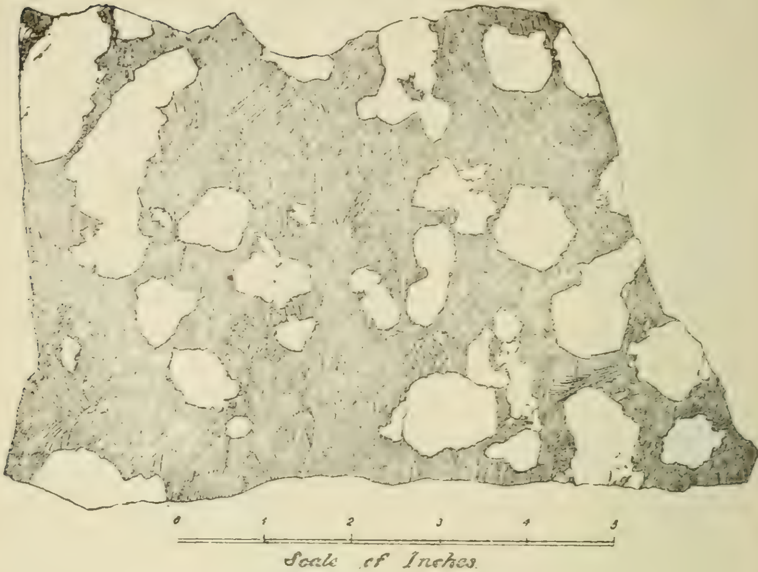
(1) See Trans-Royal Soc. Canada, Section III, 1886, p. 82.
(2) System of Mineralogy, 3rd edition, 1850, p. 313.
(3) See System of Mineralogy, 1889, p. 301.
(4) See Idem. page 34.)
(5) See Idem. page 485.
(6) System of Mineralogy, 1892, p. 340.
(7) Les Minéraux des Roches, 1888, p. 174.



CRYSTALS OF HURONITE IN DIABASE.
(Cat. No. 935, Geological Survey of Canada Museum)
From ¼ mile N. of Murphy Lake, Algoma, Ont.

The name "Huronite" has usually been restricted to yellowish green more or less rounded masses or phenocrysts, which rarely exceed two inches in diameter, embedded in a medium textured dark greenish or greyish groundmass. Many of the smaller and not a few of the larger individuals have an irregular or jagged outline owing to magmatic corrosion and frequently exhibit small arms or bays which have been filled by the invading magma. Occasionally some are seen with a more or less perfect crystallographic outline and many exhibit one or more sharp crystal faces. The mineral is light yellowish-green in colour although portions of the crystals which have undergone less alteration show a very pale flesh red or pink colour as in the case of the Murphy Lake and Eastmain specimens. The crystals weather to an opaque greyish-white forming very conspicuous spots in an otherwise dark coloured rock. Under the microscope the greenish colour is seen to be due to the more or less abundant development of

zoisite, epidote, sericite and chlorite at the expense of the original felspar. Some of the phenocrysts show a more or less perfect cleavage which is noticeably the case in the Eastmain specimen, although in the more hightly altered samples, as those from the vicinity of Missinaibi, little or none can be seen. Occasionally, crystals show macroscopically the lamellation due to polysynthetic twinning, as in some of those in the Murphy Lake diabase, but as a general rule these lamellæ are either absent altogether or so faint that they cannot be detected. The mineral is subtranslucent, varies in lustre from pearly to waxy according to degree of alteration. The hardness varies from 5½ to 6, fusibility about 5, and the specific gravity, according to Mr. R. A. A. Johnston, of the Geological Survey of Canada, varies from 2·725 in the Eastmain specimen to 2·935 in those from Missinaibi. The specific gravity, as would be expected, shows an increase in proportion to the the alteration. The microscopic examination in general reveals the fact that in every case the so-called "Huronite" is really a plagioclase near the basic end of the series which has undergone more or less complete "saussuritization." In most instances the development of zoisite, epidote, sericite, chlorite, etc., at the expense of the original felspar has been so abundant as to leave only traces of the original twinning lammellæ and occasionally to destroy all evidence of this structure. Specimens may be obtained from the large number of slides examined, showing a complete gradation of this decomposition from the pure glassy plagioclase (labradorite) composing many of the phenocrysts contained in the diabase from Temagami Lake to the completed Saussurite or Huronite in the porphyritic individuals of the Missinaibi rock. The matrix in which those phenocrysts are embedded is in general a typical diabase of dark greenish or greyish colour which likewise shows a wide difference in degree of alteration under the microscope. The specimens from Bear Island, Lake Temagami, show a very typical and fresh olivine-diabase. With the exception of some of the crystals of olivine, the rock is remarkably free from decomposition, while in the finer grained portion of the rock from Missinaibi all the component minerals have undergone great alteration. The plagioclase is more or less completely "saussuritized," the augite originally present wholly converted to hornblende (uralite) and the ilmenite replaced by the dull

gray almost opaque variety of sphene known as leucoxene. A strange fact noticed, moreover, is that frequently the less altered phenocrysts of Huronite occur in an exceedingly decomposed diabase as is the case in the Pogamasing and Eastmain specimens, while the more highly altered porphyritic individuals of this mineral are frequently developed in a groundmass more or less remarkable for its freshness. This is noticeably the case in the original specimen from the Drummond Island boulder.

The first stage in the decomposition or "saussuritization" of the plagioclase shows a cloudiness due to the development of a dull, fine grained, more or less opaque material, with a higher index of refraction causing the granules to stand out in relief from the surrounding felspar. In many cases, even in the thinnest sections, this is beyond the highest power of the microscope to resolve into its component mineral or minerals. This is accompanied, or immediately followed, by the development of sericite (hydrated muscovite) in small scales showing characteristic brilliant interference colours. The cleavage planes and fissures are seen to contain large scales and plates of this mineral, while certain other cracks and fissures are filled with chlorite and serpentine resulting from the decomposition of the bisilicates present. The smaller granules now coalesce and form larger masses and individuals of zoisite and epidote, while larger plates and scales of sericite are developed and the original plagioclase is finally replaced by a comparatively coarse grained aggregate consisting of zoisite, epidote, sericite, chlorite, calcite, and felspar. Where the alteration has been extreme, as in the case of the plagioclase originally present in the matrix of the Pogamasing specimen, the lime is more or less completely removed, and the alkaline portion of the plagioclase has crystallized into pure limpid grains of albite which seldom show twinning striations and are accordingly frequently mistaken for quartz with which they are often associated.

The larger phenocrysts very frequently showed a marked difference both in the degree and character of the alteration of their central and peripheral portions. The zoisite and epidote were much more abundant in the zone or belt immediately surrounding the crystals, while muscovite is the prevailing decomposition product present in the cen-

tral portion. In the plagioclase of the matrix the decomposition products are frequently grouped together in the central portion, leaving a comparatively clear and fresh periphery. Certain of the crystals of felspar are quite fresh and glassy, having for some reason escaped the alteration to which most have been subjected.

With the single exception, perhaps, of the plagioclase originally contained in the fine-grained portion of the rock from Pogamasing the decomposition has not been of such extreme character that secondary albite has resulted and in every other instance the clear felspar substance is certainly an unaltered survival of the original individual. The plagioclase of the groundmass is usually in more or less elongated forms, but occasionally mutual interference has produced at times rounded contours. In composition—to judge from the measurements of the angle contained between the maximum extinction of adjacent lamellae—the plagioclase appears to be always near the basic end of the felspar series. Some of the angles obtained are high enough for anorthite, the most basic of the felspars, but generally the angles obtained indicated labradorite as the most frequent source of the Huronite.

PETROGRAPHICAL DESCRIPTIONS.

1. *Locality.*—At Hudson's Bay Co.'s Post, Bear Island, Lake Temagami, District of Nipissing, Ontario. (From a boulder.)

In the hand specimen the rock is a dark green, medium textured diabase in which numerous large phenocrysts of plagioclase are developed. Most of these porphyritic crystals are more or less rounded owing to magmatic corrosion, although occasional individuals exhibit tolerably sharp and perfect crystallographic boundaries. Some of the crystals measure as much as three inches in diameter, but as a rule they vary from one to two inches across. They have in general a greenish tinge, although portions of some of the crystals show a flesh red colour. Most of this plagioclase is remarkably fresh and glassy, but the cleavage planes are very frequently coated with such alteration products as serpentine and chlorite derived from the decomposing bisilicates present in the matrix. The phenocrysts are often seen containing or invaded by portions of the finer-grained groundmass. This matrix weathers brownish or yellowish owing to the oxidation of the iron present, while

the phenocrysts of plagioclase become a dull greyish white, thus rendering the rock very conspicuous. In general the rock bears a very close megascopical resemblance to the diabase originally described as containing the Huronite while the phenocrysts themselves differ only in the degree of alteration they have undergone. The writer regards this diabase as the least altered representative of the series of rocks studied but which, under similar conditions, would have furnished a rock differing but slightly, if at all, from any of the more decomposed specimens first noticed and described as containing "Huronite."

An analysis of a portion of one of the least altered of these phenocrysts of plagioclase, kindly undertaken by Dr. Harrington of McGill University, proves the species to be labradorite. The followiug are the results :

Silica	54·19
Alumina	28·42
Ferric Oxide	0·77
Ferrous Oxide	0·41
Manganous Oxide	Trace
Lime	10·47
Magnesia	0·52
Soda	4·47
Potash	0·63
Loss on ignition	·59
	100·47

The specific gravity of carefully selected fragments with the bottle was 2 679.

Under the microscope the rock is seen to be a very typical and rather fresh olivine-diabase. In many instances the large phenocrysts are quite fresh and give the extinction angles characteristic of labradorite. Very often, however, irregular areas and patches have undergone considerable "sericitization," the resulting scales of hydrated muscovite being very minute. Occasionally this alteration is carried farther and both zoisite and epidote are present in addition to the sericite as a result of secondary action. At times a narrow border surrounding those crystals exhibits a micro-perthitic structure. A careful examination adduced sufficient evidence to indicate clearly that a more extended alter-

tion of these phenocrysts of labradorite would produce the so called Huronite. The fine-grained portion of the rock in which these crystals have been developed is a fresh aggregate composed chiefly of plagioclase (labradorite), augite and olivine. The ophitic or diabasic structure is very pronounced. The plagioclase is usually idiomorphic forming an interlacing network of lath-shaped crystals, the interstices of which are filled with augite and olivine. The augite possesses the reddish colour and pleochroism so common in diabase, the larger grains showing frequent distortion and occasional dislocation. Both the felspar and augite exhibit undulatory extinction as an effect of pressure. The olivine, as usual, occurs in irregular, more or less rounded individuals, only very rarely presenting sharp crystallographic outline. Commonly, it is rather fresh, showing a colourless or light greenish section with characteristic high relief, rough surface and brilliant interference colours. It is rarely so fresh, however, as to be without traversing fissures filled with more or less opaque alteration products. In many instances the original olivine grain is represented by a greenish or yellowish material, probably serpentine. Small scales or grains of opaque iron ore (magnetite) are associated with this serpentine indicating that they were also a result of the decomposition of the olivine. Less frequently, perhaps, the olivine shows a very interesting and rather unusual alteration to talc, but the resulting scales of this mineral were so small that this could not be ascertained beyond dispute. The talc is of a very pale green colour, slightly pleochroic, and exhibits very brilliant interference colours between crossed nicols. It occurs as a matted or felted aggregate of very minute scales filling the original olivine grain. The talc is usually accompanied by more or less opaque iron ore and occasionally some chlorite. (1) A considerable quantity of biotite is present which in some cases has undergone considerable "bleaching" owing to the removal of iron, while in other cases it is altered to chlorite. Apatite is also a tolerably abundant accessory constituent. The magnetite occurs usually in irregular black grains, most of which have resulted from the decomposi

(1) Vol. III. Geol., Wisconsin, p. 235.

tion of the olivine. Frequently, however, it occurs in tabular or rod-like forms, which are sometimes arranged in one set of parallel planes only, while in other cases they lie in two sets of planes intersecting one another. These rod-like forms penetrate all the constituents of the rock. In many instances the smaller rod-like forms occur in association with the biotite, and their correspondence in position with the planes of cleavage of this mineral suggests that in these cases. at least, their formation has been due to secondary action ("Schillerization"), involving the elimination of the iron and the development of magnetite along the planes of easy cleavage.

2. *Locality.*—S.E. $\frac{1}{4}$, N.W. $\frac{1}{4}$, Section 19, 65, 3, cutting on the Port Arthur, Duluth and Western R.R, just west of the narrows of Gunflint Lake, Minnesota. (1)

Mr. U. S. Grant, who kindly sent me the speciment at Prof. Winchell's request, says: "The rock is from one of the diabase sills (2) in the lower or iron-bearing member of the Animikie. The markedly porphyritic character is only local, the main part of the sill being without phenocrysts. These porphyritic patches are sometimes rather sharply marked off from the main mass of the sill, but they usually pass into the non-porphyritic parts simply by a gradual loss of the large crystals. This sporadic development of large felspar phenocrysts in certain of these Animikie sills is a rather common feature."

Macroscopically the rock resembles very closely the boulder brought from Lake Temagami, being a dark green diabase with phenocrysts of fresh plagioclase which exhibit the polysynthetic twin lamellation very beautifully.

The microscope reveals a rock composed mainly of plagioclase and augite with pronounced ophitic structure. The augite when fresh is of the reddish and slightly pleochroic variety so common in diabase, but it shows abundant alteration to greenish or brownish green hornblende (uralite). The opaque iron ore has the same rod-like development noticed in the examination of the preceding rock. Biotite is present

(1) Specimen No. 951, Geographical and Natural History Survey of Minnesota, collector U. S. Grant, see 22nd Annual Report, p. 82.

(2) Logan hills of Lawson, see Bulletin 8, Minnesota Survey.

and shows considerable "bleaching" and chloritization. The larger phenocrysts, which are probably labradorite, are mostly quite fresh and glassy, but irregular areas are more or less clouded by the development of minute scales of sericite or kaolin. The rock differs from the Temagami specimen in the absence of olivine and the advanced uralitization of the augite

3. *Locality.*—Landing at Silver Islet, north shore of Lake Superior.

Prof. Winchell thus describes this rock (601): (1) "A coarse porphyritic 'dioryte' in a dyke running parallel to and contiguous, to and passing into (602) a fine grained 'dioryte' in the form of a dyke. The interval of transition is perhaps two feet wide, and the crystals of felspar are scatteringly disseminated through it on the south side, and wholly disappear on the north side. They run in the same direction as the dyke on Silver Islet. The whole is 45 feet wide, but is evenly divided between Nos. 601 and 602 from about a mile north of the 'Landing at Silver Islet.'"

The thin section under the microscope showed an aggregate of plagioclase (labradorite), augite, serpentine and opaque iron ore. The phenocrysts of plagioclase as well as the lath-shaped crystals present in the groundmass show more or less 'cloudiness' due to the development of minute scales of muscovite. Irregular fissures traversing the felspar are filled with yellowish green serpentine derived from that present in the surrounding matrix. The augite, which is quite fresh, has a reddish colour, and is slightly pleochroic. It occurs in irregular grains and areas filling in the spaces between the plagioclase laths. The yellowish green serpentine, which is abundant, is present in areas whose external form and internal arrangement at once suggest its alteration from olivine, which was no doubt originally present. These phenocrysts of labradorite are much fresher than those to which the name "Huronite" has usually been applied, but under similar conditions of alteration there is no doubt that they would become so decomposed as to be indistinguishable from this mineral.

(1) Specimens Nos. 601 and 602, 10th Annual Report of Geological and Natural History Survey, Minnesota, page 56.

4. *Locality.*—Knob or Fault Hill, west branch Hamilton River, 20 miles below old Fort Nascawpee on Lake Petitsikpo v, (1) Labrador Peninsula.

The specimen, according to Mr. A. P. Low, is from a dyke cutting the ferruginous limestones and shales of Knob or Fault Hill, a prominent topographical feature, as it rises rather abruptly to the height of 350 feet above the surrounding country. The dyke occupies the summit of the hill, while 200 feet below come in the stratified rocks through which it has been intruded. Neither the width of the dyke nor the nature of its contact with the bedded rocks could be ascertained owing to the accumulation of drift material, but it certainly cannot be much less than 200 yards.

Macroscopically the hand specimen shows a medium textured dark green almost black diabase containing occasional small and imperfect phenocrysts of a light greenish grey plagioclase which has undergone incipient "saussuritization." Under the microscope the rock is seen to be composed of an aggregate of plagioclase, augite, serpentine, and ilmenite. The augite is very fresh, has a light brownish red colour and shows a marked pleochroism. In general its form is allotriomorphic, filling in the spaces between the felspar, but occasional individuals exhibit sharp and perfect crystal boundaries. The plagioclase occurs in more or less elongated lath-shaped crystals which are often somewhat stout and rounded thus producing a rather coarse ophitic structure. Many of the small individuals are quite fresh, but the larger ones show considerable alteration to sericite and epidote. The resulting "saussurite" is in no instance so abundantly developed as to destroy the polysynthetic twinning striæ. The large amount of serpentine noticed in this rock has evidently resulted from the decomposition of olivine originally present. The serpentinization of the olivine is in every instance completed, and only the outline and structure of the serpentine individuals serve to indicate the mineral from which it has been derived. These occasionally show a network of fibrous serpentine which was first produced, the greenish fibres standing perpendicular to the cracks along which they have been developed. Owing

(1) Reference No. 4, A, p. 28, Book II., Low, 21/6/94.

to this parallel arrangement of the fibres, the serpentinous substance gives a faint but definite reaction with polarized light. The meshes of the net-like structure thus produced are filled with more finely developed scales and fibres of serpentine which are nearly, if not, quite isotropic. These decomposed grains are often seen embedded in the fresh augite. The ilmenite occurs in large irregular fragments or in small more or less rounded granules and in both cases shows characteristic alteration to leucoxene. The leucoxene is of the usual opaque grey colour, but sometimes brownish grey, and frequently show, especially in the thinner portions of the slide as also the smaller fragments, the brilliant chromatic polarization of sphene of which it is simply a variety.

5. *Locality.*—¼ mile north of Murphy Lake, Timber Limit, 90, District of Algoma, Ont.

The specimen is from a dyke cutting rocks of Huronian age. The matrix is a normal dark green diabase whose ophitic structure is megascopically apparent. A freshly exposed surface shows the Huronite to be of the usual pale yellowish green colour, while the less altered portions of the crystals have a more or less pinkish or flesh red colour. In many of these individuals a somewhat indistinct cleavage and a rather faint striation due to multiple twinning may be seen. The matrix weathers a brownish colour while the phenocrysts become a dull opaque greyish white thus rendering portions of this rock which have been subjected to atmospheric action very conspicuous.

Microscopically, the Huronite is seen to be labradorite which has undergone more or less "saussuritization." A narrow border usually surrounds these phenocrysts of labradorite which is free from the products of decomposition, but immediately within this rim is a zone or band where the alteration has been extreme and here the resulting zoisite, epidote and sericite replace nearly, if not quite, all of the original felspar. The epidote and zoisite are present in irregular grains or masses, while the sericite, as usual, occurs in scales and plates. All of these alteration products have a more or less definite arrangement. The grains and imperfect crystals of epidote and zoisite are usually elongated in a direction corresponding more or less with the twinning striations

or in a direction nearly at right angles while the scales and plates of sericite have a similar development.

The specific gravity, ascertained by Mr. R. A. A, Johnston, of these porphyritic crystals was 2·758.

The matrix of these crystals is a rather fresh diabase with pronounced ophitic structure and composed chiefly of plagioclase and augite. The plagioclase is idiomorphic and forms an interlacing network of lath-shaped crystals. Occasional crystals are rather fresh and glassy, but usually they exhibit the same alteration as the larger porphyritic individuals, and apparently belong to the same species of felspar (labradorite). The decomposition products aggregate themselves toward the centre of the crystal leaving a somewhat fresh periphery. The augite is in general quite fresh, but occasionally an individual was seen partially altered into green, strongly trichroic hornblende. Twins are common. A considerable quantity of biotite is present which is always more or less altered to chlorite. Ilmenite, an abundant constituent, occurs in irregular grains and only shows incipient alteration to leucoxene. Occasional prisms of apatite were noticed, chiefly developed in the chloritized biotite. The more unaltered portions of the plagioclase show the undulatory extinction due to pressure. Pyrite is also an abundant constituent.

6. *Locality.*—Algoma Mills, north shore of Lake Huron, district of Algoma, Ontario. (1)

The thin section exhibits a rock very similar to the one just described and must be regarded as being derived from a dyke almost analagous in character and composition to that exposed near Murphy Lake.

The phenocrysts of labradorite show the usual alteration into an aggregate composed chiefly of muscovite, epidote and zoisite although considerable portions of some of the crystals are free from these decomposition products. The augite has a light yellowish colour and is only slightly pleochroic. Twins are common, the twinning plane and composition face being the orthopinacoid.

Curved or distorted individuals were often noticed exhibiting the

*From a boulder No. 1605, Geological Survey of Minnesota, series of rocks, 18th Annual report, page 58.

"strain shadows" due to pressure. A good proportion showed an incipient uralitization. The plagioclase of the groundmass has also undergone more or less "saussuritization" and occurs in stout and rounded laths thus producing a rather coarse ophitic structure. The ilmenite present in irregular grains is often fresh but shows occasional incipient alteration to leucoxene. A small amount of chlorite is also present.

7. *Locality*—Shore of Drummond Island, Lake Huron, (from a boulder.)

The slide was made from a fragment, obtained through the kindness of Dr. Harrington, from a duplicate specimen of the original boulder at present in the Holmes collection of the Peter Redpath Museum of McGill University. The first examination and analysis by Dr. Thomson was rather imperfect as pointed out by Dr. Harrington (1) but it has been thought advisable to reproduce the analysis, though imperfect, for purposes of rough comparison. This analysis is as follows:

Silica	45·80
Alumina	33·92
Ferrous Oxide	4·32
Lime	8·04
Magnesia	1·72
Loss on ignition	4.16
	97·96

The specific gravity, according to Dr. Thomson, is 2·8625. Under the microscope the phenocrysts of the so-called "Huronite" are seen to be a decomposed aggregate of zoisite, muscovite, epidote, calcite, chlorite and felspar. Occasionally there is a very narrow border of comparatively unaltered felspar surrounding these individuals, in which traces of the very fine striation, due to multiple twinning, may be observed. Immediately within this band, however, the decomposition products are most abundant, and the original plagioclase is replaced almost altogether by epidote, zoisite and muscovite, their relative abundance being in the order mentioned, while the interior of the crystals is composed mainly of muscovite with a much less proportion of zoisite, epidote and felspar.

(1) Trans. Royal Society of Canada, Section III., 1886, p. 82.

The epidote and zoisite occur in irregular, often somewhat elongated masses or "grape-like" bunches which frequently show a more or less definite arrangemenr in accordance with the structure of the original felspar. Both minerals exhibit their characteristic high relief, the epidote showing brilliant chromatic polarization colours, and yellow to colourless pleochroism, while the interference colours of the zoisite, as usual, are very low, dull bluish to yellowish. The sericite is of a very pale green, and occurs in scales or aggregates of scales and plates, showing customary brilliant polarization colours and parallel extinction. The sericite has, likewise, often a definite arrangement, but sometimes occurs in irregular or matted aggregates. The "saussuritization" of the original plagioclase has been usually so complete, that only traces of the twinning lamellæ can be detected. The matrix in which these crystals are embedded is a diabase, composed essentially of plagioclase and augite. The plagioclase shows more or less alteration, identical in character with that of the larger phenocrysts so that it must have had a similar composition. It occurs as lath-shaped, twin crystals, often consisting of only two lamellæ, which pierce, and are often embedded in the augite. The augite occurs in more or less irregular masses, filling in the interstices between the felspar laths. It is light brownish in colour, exhibits a faint pleochroism, and the characteristic interrupted cleavages in cross-section. It is partially altered into green trichroic hornblende, and occasionally the alteration has been carried so far that chlorite has resulted. This uralitization has only proceeded to a limited extent, and is confined to a narrow margin surrounding the irregular fissures traversing the augite masses. Occasional twins were noticed, the twinning plane being the orthopinacoid.

Ilmenite is abundant, but almost wholly converted into leucoxene. The fragments have generally jagged and irregular contours, but occasionally, some are seen which possess a rather perfect crystallographic outline. The characteristic alteration along lines parallel to the faces of the rhombohedron produces alternating bands of greyish white leucoxene, and black, unaltered ilmenite. The less altered portions of the plagioclase and the augite show uneven or wavy extinction, the "strain shadows" induced in the latter being especially well marked,

and is a noticeable and interesting feature in connection with the rock. Additional evidence of pressure is furnished by the frequent distortion and even dislocation of both the plagioclase and augite individuals.

8. *Locality.*—About 4 miles N.W. Pogamasing Station, main line, Canadian Pacific Railway, District of Algoma, Ont.

The specimen was obtained from a dyke, cutting the granitoid gneisses of the Laurentian. The phenocrysts of "Huronite" have generally a rude, rounded outline, the largest of which are about two inches in diameter. Many of the smaller ones have irregular or jagged outline, and occasional individuals exhibit some of the sharp faces of the original crystal. The mineral is of the usual light, yellowish-green colour, shows the glistening surfaces of the indistinct cleavage and occasional faint-striæ. It is sub translucent, has a waxy lustre, and a somewhat "soapy" feel. According to Dr. Harrington* "the hardness is 5½ or a little over, fusibility about 5, and specific gravity 2·814." An analysis of some of the material composing these phenocrysts was made by Mr. N. N. Evans, of McGill University, for Dr. Harrington, with the following results :

*Trans. Royal Soc. Canada, Sec. III, 1886, p. 82.

Silica	47·07
Alumina	32·49
Ferric Oxide	0·97
Lime	13·30
Magnesia	0·22
Potash	2·88
Soda	2·03
Loss on ignition	2·72
	101·68

The matrix in which these crystals are developed is a fine-grained dark green diabase, with abundantly disseminated particles of iron pyrites.

Uuder the microscope the "Hurcnite" is seen to consist of an aggregate of epidote, zoisite, sericite and chlorite, but in the larger crystals especially, considerable areas of unaltered plagioclase exist which are quite fresh and glassy, and exhibit the twinning lamellae quite distinctly. The smaller phenocrysts, however, are altogether

decomposed so that there is little or no evidence of the lamellation of the original felspar. The matrix in which these crystals are embedded is an exceedingly decomposed groundmass made up of felspar, epidote, chlorite, hornblende and zoisite, with larger individuals of augite in a more or less advanced stage of uralitization. The alteration to hornblende is mainly marginal and has proceeded very unevenly, the core of unaltered augite, having thus a very irregular outline. The augite has a brownish colour and exhibits the characteristic interrupted cleavages in cross-section. The larger individuals are all twinned, the twinning plane being the orthopinacoid. The rock is so decomposed that the original ophitic structure is nearly, if not quite, obliterated. Very little trace, if any, remains of the original plagioclase of the ground mass, and instead small areas or fragments of a water-clear unstriated felspar (albite ?) are present which are evidently secondary, as they contain minute embedded needless of the secondary epidote. This water clear secondary felspar has evidently been developed at the expense of the original plagioclase. (1)

A considerable amount of ilmenite was originally present, but is now almost altogether decomposed to leucoxene. This greyish white translucent mineral occurs in masses which are generally irregular or have a rude rhombic outline, and frequently exhibits the very characteristic alteration along lines or zones parallel to the faces of the rhombohedron. The thinnest section shows the mineral to be made up of an aggregate of minute rounded grains with a high index of refraction and showing brilliant interference colours. (2)

9. *Locality.*—10 miles north of Lake Kawachagami, on the portage route between the Rupert and Eastmain rivers, in the peninsula of Labrador, Geo. Survey of Canada, Eastmain River. (3)

Macroscopically a dark greenish grey gabbro with yellowish green phenocrysts of plagioclase. The phenocrysts have a tolerably sharp, through irregular outline, the larger ones being over an inch in diameter.

Under the microscope the rock is seen to be composed mainly of plagioclase, augite and ilmenite. In places a coarse ophitic structure can

(1) Teall, British Petrography, p. 230.

(2) Notes on the microscopic structure of some rocks of the Quebec Group—Frank D. Adams—Geo. Survey, Canada, Report Progress, 1880-82, p. 16, A.

(3) Reference No. 1, p. 12, Book II, 12/7/92, Low.

be seen and the specimen doubtless represents the "granitoid" structure so characteristic of the centre portion of most diabase dykes which nearer their margin exhibit the typical ophitic structure. The larger phenocrysts show a marked alteration. Most of the sections of these crystals are made up of innumerable minute scales and fibres of light greenish sericite arranged parallel to the polysynthetic twinning lines, and therefore even where the alteration has proceeded farthest the direction of the very fine striation may still be ascertained. Zoisite and epidote have also been developed the former usually in more or less elongated prisms or lath-shaped crystals, occurring either isolated or in irregularly disposed groups. The epidote is present in irregular grains or associated with calcite filling certain fissures in the crystals. Some portions of the crystals which had escaped alteration had a distinctly reddish colour and revealed the fine twinning striæ. The crystals are precisely similar to those decribed by Thompson as "Huronite." The specific gravity of these crystals, according to Mr. R. A. A. Johnston, is 2·725. The augite has undergone more or less complete uralitization, although in most cases cores of unaltered material remain. During this process a certain amount of epidote present in the slide has been formed. The plagioclase of the matrix shows the same alteration or "saussuritization" as the larger phenocrysts, the decomposition products aggregating themselves towards the centre leaving a comparatively fresh periphery. Ilmenite is a rather abundant constituent and occasionally shows incipient alteration to leucoxene. Apatite is very abundant. The interlamination of quartz and felspar, known as granophyre, is present in considerable quantity.

10. *Locality* near Missinaibi Station, on the main line of the Canadian Pacific Railway, District of Algoma, Ont.

The specimen examined was obtained by Dr. Selwyn from one of several dykes which cut both the Huronian and Laurentian rock exposed in this region. It is a medium grained dark greyish green diabase whose ophitic structure is megascopically apparent. The porphyritic crystals vary from a pale greyish green to a light yellow green, weathering to a light grey on exposed surfaces. Very frequently they have tolerably good crystallographic boundaries, although in most cases

especially in the smaller individuals they have a rather irregular outline. The specific gravity of these crystals ascertained by Mr. R. A. A. Johnston was 2·935.

Under the microscope these phenocrysts show a very advanced stage of alteration and the original plagioclase is now replaced by an aggregate of muscovite, zoisite, epidote, felspar and calcite. There is little or no trace left of the original twinning lamellae. The plagioclase laths present in the enclosing matrix show a similar alteration, although not to so large an extent. The augite originally present is now replaced by hornblende (uralite) and often the alteration has proceeded so far that chlorite has resulted. These resulting products of decomposition fill the original allotriomorphic individuals of augite. These individuals as now present usually exhibit a deep green border of strongly trichroic hornblende, while the interior is occupied by an aggregate of interlacing fibres of light green hornblende with more or less chlorite. Traces of the characteristic interrupted cleavages of augite are present in occasional grains, but no unaltered cores now remain. The resemblence to other uralitic hornblende is, however, unmistakable. (1) The hornblende also bears a close resemblence to that present in the rock just described (No. 9) in which cores of the original augite are still present. The ilmenite present is more or less altered to leucoxene showing brilliant polarization colours (compare No. 8 ante). A considerable amount of biotite of a light brown colour on account of the "bleaching" it has undergone shows rather brilliant interference colours. The biotite has also been altered in many cases to chlorite. Granophyre structure was also noticed.

11. Locality.—Lake Petitsikapow, about 15 miles below old Fort Nascawpee. West branch Hamilton River. Labrador Peninsula. (2)

The dyke from which the sample was taken, according to Mr. Low, is 200 yards in width, coarsely crystalline in the centre where the porphyritic individuals of Huronite are often three-fourths of an inch in diameter. The dyke breaks through and alters sandstones, limestones

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(1) Williams' Appendix I., Part F., Annual Report, Geological Survey of Canada, Vol. V., 1889-90, p. 60.

(2) Reference No. 4, p. 30, Bk. II. Low, 23/6/94.

and shales of Cambrian age, running almost parallel to their strike. The specimen was taken from near the middle of this dyke, and shows macroscopically a dark greenish grey, rather coarse grained diabase, in which are embedded numerous phenocrysts of altered greenish felspar (Huronite). The crystals of "Huronite," though much smaller than usual, are on the other hand much more abundant, so that it is often difficult to obtain even a small chip of the finer groundmass, in which they are embedded. The felspar of both the larger porphyritic individuals and those present in the groundmass show great alteration, although the polysynthetic twinning lamellæ may still be recognized. The decomposition products are mainly sericite and epidote. The specific gravity of these phenocrysts according to Mr. Johnston, is 2.773. The augite when fresh (which is rarely the case except in very minute fragments), is of a reddish colour, and shows distinct pleochroison. A great deal of chlorite is present. The ilmenite occurs in irregular grains as well as fragments, which have a more or less perfect crystallographic outline and occasional perfect rhombohedra were noticed. The alteration to leucoxene is very characteristic, this resulting form of sphene frequently exhibiting its characteristic brilliant chromatic polarization in thin sections. (1) Besides these larger fragments small rounded grains of a brownish grey translucent mineral occur with high index of refraction, and show brilliant interference colours. These occasionally show small granules in the centre of unaltered titanic iron ore, and thus reveal their derivation. Apatite is very abundant, and occurs in colourless prismatic needles which are frequently bent, cracked and broken. Pyrite is also a rather abundant accessory constituent.

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(1) Page 16 A, Report Geological Survey of Canada, 1880-2.

HUNTING THE BARREN GROUND CARIBOU.

By FRANK RUSSELL, of the State University of Iowa.

Vague rumors had reached Fort Rae concerning the whereabouts of the "deer" during the last week of October, but it was not until the first of November that a party left the post to hunt them.

A few years ago the Barren Ground Caribou appeared about the fort regularly upon All Saints Day. They were often killed from the buildings, and throughout the winter might be found near the post. In 1877 an unbroken line of caribou crossed the frozen lake near the fort, they were fourteen days in passing and in such a mass that, in the words of an eye witness, "daylight could not be seen" through the column. They are now seldom seen within several miles of Rae.

The "Fort Hunter," Tenony, with seven of his followers was just starting upon a seventy-five mile journey toward the north on the evening of the first, when I learned of his intentions, and after agreeing to furnish a few "skins" of flour, tea, and tobacco, and to pay a skin a day for a dog driver it was settled that I might accompany them into the hunting grounds where another chief, Naohmby, had objected to my going three months before, on the ground that all the game would desert the country if pursued by a naturalist.

I loaded my sled with thirty white fish, three days provisions for the dogs, and fifteen pounds of "dry meat" for the "boy," while I shared alternately with each of them during the trip, the rank, "hung fish" driving me to dried meat and the leathery slabs compelling me to return to the fish.

As the "brigade" only intended getting clear of the fort that evening I preferred to remain and make an early start the next day. We left the fort at daylight on the second, Yahty running before my dogs. Our course was northward for twelve miles, to the end of the Northern Arm of the Great Slave Lake, whence a channel a hundred yards in width called Willow River continues for half a mile before expanding into a small lake extending toward the northeast and connecting by a number of "schnys" with Lac Brochet. Following the eastern shore of the small lake, we crossed a short portage and traversing a narrow

channel for a couple of miles reached Sah-kah-tohn-tooh, the Lake of the Bear's Shoulder. This body of water must exceed twenty-five miles in length.

We did not succeed in overtaking Tenony but encamped near the end of the lake with an Indian, who, with his ten year old son and three miserable "giddies"—Indian dogs—was also in quest of the caribou. He carried a powder horn differing from any that I saw in the North. It was made by boring or burning out a section of the bram of a caribou's antler. He would smilingly beg for tea and tobacco, not becoming in the least disheartened by repeated refusals. I was glad to escape his importunities by leaving camp at 4 a.m. The brisk trot of our well-fed team soon carried us out of reach of the yells of the giddies as the lash was unsparingly applied in his efforts to keep up with the "Mollah" who had such quantities of "lee tea" and "tobah."

Passing a couple of miles of short portages we reached another large lake called by the Dog Ribs, Quem-tah-Tooh, the Lake of the White Rock, where we found Tenony encamped.

The Indians had been aroused by their dogs greeting our approach with barks and howls and were huddled behind a roaring fire with their blankets, once white, now a dirty gray, thrown over their shoulders, their hands outstretched toward the welcome blaze while they guarded the few frozen fish which were thawing and burning at their feet. Behind them a confused mass of dog harness, wrappers, and flat sleds formed a barrier to keep out a score or more of giddies which were crowding about the camp and fighting for an advantageous position from which to watch for the few bones that escaped their master's teeth. After "drinking tea" we followed the lake shore toward the northwest where a range of granite hills, called Sah-me-t'ie-kfwa, rose high above the general level of the somewhat rugged country about them.

When close to the hills we discovered a small band of caribou toward which the dogs started at their best pace, barking and straining at their collars, and urged to greater exertion by the men who shouted "Ayee ecwoh, m'nitla" (There are the caribou, now, go!). The alarmed caribou were dashing about in all directions yet managing to keep out of range though several shots were fired before they entered the tim-

ber. Around us rose the precipitous snow covered mountains through a gap of which a large stream entered the lake, its cascades giving off clouds of vapor. High above us a bald eagle wheeled in majestic flight with white head and crissum flashing in the light of the rising sun. Cutting our way through a brulé we reached another lake upon which there was an abundance of fresh tracks. An hour later I left the others and started down the lake with the boy before the dogs. Three or four bands of caribou, perhaps fifty in all, soon came out upon the ice. Yahty ran toward the nearest of them followed by the dogs which dashed past him at full cry as soon as they discovered the caribou. I was seated upon the sled while Yahty ran, holding the sled line in a cloud of snow which trailed out behind like the tail of a comet.

The caribou stood motionless until we were within a couple of hundred yards before making off: they soon stopped, side on, to survey their pursuers, snuffing the air for a moment; they would throw back their heads and leap high in the air, and again dash away at a swift run, passing patches of smooth ice without a miss step.

The drifts were small, but the snow was well hardened making a rough surface for the swift flying sled. Just as I would be about to pull the trigger after taking hasty aim a sudden lurch would nearly dislodge me from my seat and perhaps send the muzzle of the rifle skywards. I succeeded in killing two and breaking a fore leg of another which ran with undiminished speed, in fact led the band as they entered the timber and so escaped.

Placing a row of pine boughs at intervals of fifteen or twenty yards quite across an arm of the lake we concealed ourselves on shore, and waited the appearance of the caribou. Only one band approached our barrier which they followed some distance, but did not venture to cross; they turned away before coming within range, but the following day we were more successful in employing this, a common device of the Dog Ribs.

That evening we feasted until a late hour upon the first caribou meat of the season. Several heads were skinned and hung from poles before the fire by the mitten cords of the owners and willow hooks. As soon as the outside was roasted the jaw was turned back and the tongue, one of the choicest bits of all, slightly cooked. The dogs were

well fed for the first time in months; we gave them the quarters only, and cracked the long bones for the marrow which, raw or roasted, is one of the greatest of Dog Rib luxuries. Look down in pity upon "the savage and his marrow bones" if you will, but you might perhaps relish that same marrow if you had "hustled" for those bones yourself as I had done, or you might after running fifty miles pass your plate a second time for bouillon made of blood carried to camp in a caribou's stomach. Even the tendons were eaten and the feet also, after roasting them until the hoof could be knocked off.

Although I lived some time with the Dog Ribs and spent over a year in their territory, I never knew of their eating the contents of the caribou's stomach as do the Eskimos. The unborn calf, the udder of a milk-giving cow, the tongue, the marrow and back fat are the parts held in highest esteem.

Tenony fulfilled his promise of returning after "five sleeps," but marched fifty miles against a heavy gale of wind upon the sixth day to do it.

The caribou came but little nearer during the winter of 1893-84. I made three other trips in search of them and travelled five hundred miles in all, driving my own dogs after the first hunt with Tenony. Out of a large number secured, I selected eight choice specimens, and during the winter obtained the skin of an albino, for the museum of the State University of Iowa. Albinism is of rare occurrence among the Barren Ground Caribou. One of the oldest Dog Ribs assured me that he had never seen a "white deer."

Authorities differ as to the time when the antlers are cast.

The new horn begins to grow late in April and the velvet is not all cleared off until November. The old males shed their antlers in December. While in the Barren Ground in March and April, I saw large numbers of both sexes with antlers, and on the 5th of April I killed a buck, four or five years of age, still bearing them. At that season we saw thousands of caribou in the vicinity of Bathurst Inlet, which had evidently wintered there and not approached the woods as in former years.

It is said that only the females reach the sea coast where they drop their young in June. Yet I have seen both male and female caribou wading in the shoal water of the Arctic Ocean south of Herschel Island in July.

TOWN BIRDS.

By W. A. D. LEES.

(*Read before the Ottawa Field Naturalist's Club, 14th March, 1895.*)

After a year or two with little opportunity to be in the woods or on the waters where birds are most commonly found, one has not much to report of their doings, and hence I am constrained to-night to confine my remarks to "Town Birds." Everyone of us may see something of these as he goes about the city on his daily business, and to one who has not given the subject much attention it is astonishing what a number of species are found even in the busiest streets.

For the student of birds, as well as for those who have only a very casual acquaintance with them, there is always something new in store, even among the town birds. Seven years ago yesterday, near the corner of Maria and Metcalfe streets when I was only beginning, as they say with children, to "take notice" of birds, I came upon a flock of Purple Finches (I think the other name of Red Linnet, is a better one) and was thrilled by the brilliant colour of their plumage, which to my unpractised eye seemed as if stained by the rowan berries upon which they were feeding. Less than a month ago, at the same street corner, I saw my first flock of those erratic winter visitants the Bohemian Waxwings, and I do not think that either the lapse of years, or the number of birds I have come to know since those first red linnets, in any degree lessened the thrill of pleasure with which I welcomed another new acquaintance to the list of my bird friends.

The rowan trees along the streets and in public and private grounds, when in fruit, give us many opportunities of seeing birds which, like these Waxwings, visit us from the far north. Most of you will remember how, some ten years ago, the Pine Grosbeaks came down in such numbers, and were so apparently indifferent to the presence of man, that they might almost be taken by hand as they fed upon the berries dropped by their hungry comrades in the trees, upon the snow beneath.

Almost every neglected vacant lot with its crop of weed seeds attracts in due time its roving flock of Redpolls, or their near relatives the Goldfinches, for these latter often spend the winter with us, escap-

ing, in their sober garb of olive brown, the observation of those who only know them in the brilliant black and gold of Summer. Pine Siskins too may be looked for whenever and wherever the white cedars have cones, in the seeds of which they seem especially to delight, and wherever such small game abounds, one has not far to seek their handsome and voluble but deceitful enemy the Shrike. Hawks too are more or less common according to the food supply, and my note-book gives me both winter and summer records of the Sparrow Hawk in the busiest parts of the city.

A hawk was captured alive last fall at the City Hall square, and kept some time in confinement, but proving an undesirable pet, it passed from one owner to another and at last made its escape. I did not ascertain its species, but a remarkably tall legend connected with its final disappearance might readily suggest the possibility of its having been a Fish-hawk.

Even such a man-hater as the Ruffed Grouse, or as we commonly, but I believe incorrectly, call him, the Partridge, occasionally pays the city a visit, and has been known to fly through the glass of a window and land on the dining room table, a place to which, under the stringency of the present game laws, he usually finds his way by a less direct route, and, I might add, under a different name from either of the above.

Turning now to the summer birds, many are almost too common to need mention: such, for instance as the omnivorous and belligerent House Sparrow, for whom the name English, or even European, is now more of a misnomer than ever, since he has annexed the whole American continent. The Robin and the Song Sparrow may be heard and seen in all parts of the city, and the Night Hawk and Chimney Swift, in their season, are familiar objects to all who even glance upward. One of the former seated on a flat roof forms the subject of a very good photograph, edited (if I may use the term) by one of our members, who was quick enough to take advantage of the situation from the back window of a Sparks Street studio. Tree Swallows and Purple Martins are only a little less common, both species being regular summer boarders at the Albion Hotel, which has long since ceased to entertain other guests

than these occupants of its sky parlors. Many a period of enforced waiting in an unattractive court room across the street has been pleasantly relieved by these same birds. From the windows of the same building I have often caught other little glimpses of bird-life without, which were in pleasing contrast with the glimpses of man-life to be had within. Here I have seen amongst others, Chipping Sparrows, Yellow Warblers, Warbling Vireos, Downy Woodpeckers, and Cedar Waxwings; a pair of the last industriously ridding the ash trees of caterpillars, and so close that I could easily distinguish the red wax-like appendages to the wing-tips, from which the bird takes it name. These birds are in due season also industrious fly-catchers, working in exactly the same way as the true *Tyrannidæ*, and so it is a question if, after all, they do not earn a right to at least some of the fruit they so greedily consume.

Amongst other birds more or less common in busy parts of the city may be named Bluebirds, Vesper Sparrows, and Savanna Sparrows, and even that handsome Woodpecker, from whose thirty or more names the American Ornithologist's Union has chosen "Flicker," appears in my note-book as a town bird.

That surprises are often in store for the observer of town birds is shown by such records as those of a Brown Creeper climbing a telegraph pole at the corner of Elgin and Queen streets, a Red-breasted Nuthatch on another telegraph pole at the corner of Elgin and Nepean streets, and a Wood Peewee in the back-yard of a Sparks street hardware store.

It will be noticed that in the above paper I have made no mention of the various small patches of wood-land in outlying parts of the city, such as those about Patterson's Creek, the old race-course, McKay's bush, and the like, where nine-tenths of all the birds that visit the district may be noted by a careful observer, while the Lovers' Walk and Major's Hill Park, in the very heart of the city will furnish records of many of the rarest and most retiring of our wood-birds. Neither have I mentioned another favorite haunt of the birds on Sussex street where the very shyest of them are so tame that they never leave their perches, even on the nearest approach of man. I mean the Geological Survey Museum.

JAMES DWIGHT DANA.

James Dwight Dana, one of the fathers of American Geological Science, died at his home in New Haven, Conn., Easter Sunday, the 14th day of April, 1895. He was born at Utica, N.Y., February 12th, 1813, and was therefore in his 83rd year. He graduated at Yale when only twenty years of age, and evinced great aptitude for the natural sciences and mathematics. For two years he was teacher of mathematics in the U.S. Navy. He is next seen as assistant to Prof. Silliman at Yale College. In 1838 he published "A System of Mineralogy," which won for him the admiration of the scientists of two continents as mineralogist and geoloist. In 1838, he sailed for the Southern and Pacific Oceans, with Lieut. Wilkes, in charge of the squadron, whose expedition lasted four years. "*A Report on Crustacea*," 1852-4. "*Report on Zoophytes*," 1846; "*Report on the Geology of the Pacific*, 1849; besides "*Science and the Bible*," in Bibliotheca Sacra, published in 1856-7, occupied his time during the 15 years which followed his return from the Wilkes expedition. In 1885 Dana succeeded Prof. Silliman as Prof. of Natural History and Geology at Yale. His first "Manual of Geology" was published in 1863—this was followed by a "Text Book of Geology for Schools and Academies," 1864. and latterly "Corals and Coral Islands" in 1872. In this year he was awarded the *Wollaston* gold medal by the Geological Society of London. He was elected President of the American Association Adv. Science for the first time in 1854, and was an honorary, corresponding or active fellow of nearly all the Geological Societies of Europe und America. His contributions and numerous writings in Silliman's Journal as one of its editors, in the Trans. Acad. Nat. Sc. of Philadelphia, in the Proc. Amer. Acad. Sc. and Arts and in numerous other channels are too well known to be commented upon in a passing sketch like this. He had just completed the last edition of his "Manual of Geology" which had been used so extensively as a text book in the colleges and universities of America and Europe. His was a life of genuine usefulness to his generation.

NOTES, REVIEWS, AND COMMENTS.

Geology.—BAILEY, PROF. L. W., M.A., Ph. D., F.R.S.C.—"*Preliminary Report on Geological investigations in south-western Nova Scotia.*" Being Report Q. of Vol. VI., Annual Report, Geological Survey of Canada, 1892-93, published 1895, 21 pp.

Pending the publication of Dr. Bailey's final report addressed to the Director of the Geological Survey of Canada, the preliminary report here referred to has been published and forms part of the 6th Annual Report of the Geological Survey. The delineation of the **granite areas** in South-Western Nova Scotia, the South and Blue Mountains, Tusket Wedge, the Barrington area, the Shelbourne and Port Mouton areas are given and the reader is referred to **Sir Archibald Geikie's** descriptions of South-Eastern Ireland as applying, almost word for word, to the granites of South-Western Nova Scotia. The **Cambrian Succession**, as seen in Queen's Co., is carefully described and the possible existence of pre-Cambrian rocks pointed out. As to the **Devonian System** our knowledge was still incomplete. On pp. 14 and 15, a brief summary of the palæontological results obtained by Dr. Ami after examining the collections in the Peter Redpath Museum and in the possesion of the Geological Survey is given. Most of the collections from Nictau point to **Eo-Devonian** time. The **Triassic** and **Post-Tertiary** system are next discussed, and the economic minerals receive considerable attention.

MATTHEW, G. F., Dr., M.A., F.R.S.C., "*Early Protozoa*," "The American Geologist"—Vol. XV., No. 3, pp. 146-153, March, 1895.

In this paper the author reviews Mr. L. Cayeux's paper describing certain so called Pre-Cambrian Radiolaria. No less than 45 different kinds of rhizopods have been described and are figured on one plate.

Mr. Cayeux's microscopic slides were examined both by Dr. G. J. Hinde, of London, England, and by Dr. Rüst, of Hanover, Germany. These two gentlemen, whilst not agreeing with his (Cayeux's) conclusions, admitted that the forms were organic."

WINCHELL, W. H., PROF.—"*The Stratigraphic base of the Taconic or Lower Cambrian.*"—"The American Geologist," Vol. XV., No. 3, pp. 153-162, March, 1895.

This contains a general sketch of the history of geological investigations, both in Great Britain and America, regarding the base of the fossiliferous series—of the lower Cambrian. The views held by Sedgwick, Murchison, Dr. Hicks, by Barrande in Bohemia by Sir Archibald Geikie are freely quoted—whilst in America those of Dana, Logan, Walcott, Selwyn, Ells, Van Hise and others are also cited. Director Howley's work in Newfoundland is likewise referred to, as well as Dr. Matthew's researches in New Brunswick.

TAYLOR, FRANK B.—"*The Second Lake Algonquin.*" The American Geologist, Vol. XV., No. 3, pp. 162-179, March, 1895.

This contains the concluding article by Mr. Taylor on the above subject as elaborated from data obtained in the North Bay and surrounding district around Lake Nipissing in Canada.

"The attitude of the deformed plane:" the order of changes in Niagara and Lake Algonquin, the St. Clair Flats, evidence of recent elevation and tilting in contiguous regions—all are elaborately discussed. Mr. Taylor sums up his conclusions regarding the rise and fall of the waters in the straits and lake of Nipissing—of Superior and Lake Erie. The suggestive facts mentioned point," naturally, "to a correlation with the eastward uplift which deformed the Nipissing plane with the elevation of the north-eastern barrier of Lake Ontario and of the deposits of the Champlain submergence, in the Champlain, Lower St. Lawrence, and Hudson Bay areas.

GIRTY, GEO. H.—*Development of the corallum of Favosites Forbisi, Var. occidentalis.*"—The American Geologist, Vol. XV., No. 3, pp. 131-146, March, 1895.

Mr. Girty, who has carried on his researches at Yale, under Dr. C. E. Beecher, describes *five* stages in the growth of the corallum of the above species. He carefully describes the interstilial cells or buds which can appear only when divergence of the older corallites permits—usually "in the angles where the older corallites meet."

Favosites spinigeurs, Hall, and *F. conicus*, Hall, both Silurian corals, have also received attention and study for comparison, likewise *F. hemisphericus*. Mr. Girty observes the noticeable fact that the initial corallite in Favosites gives rise to buds which are (1) *four* in number, and (2) all on one side (dorsal) of the corallum. *Favosites* presents an

interesting form for the study of mural pores and their relations. The affinities of this genus are likewise discussed and seem to point to Aulopora and Romingeria—rather than any other genera of the *perforata* excepting Michelinia and Pleurodictyum. The first stage of Pleurodictyum and of Favosites is an auloporoid stage represented by the initial cell.

Geology of Aylmer—On the 27th of March, 1895, one of our members, Mr. T. W. E. Sowter, delivered a lecture on the "**Palæontology** and **Geology** of **Aylmer** at the Academy. The lecture proved to be very interesting and was illustrated by a large suite of specimens consisting of rocks and fossils, some new to science. We are pleased to state that we expect to receive a paper from Mr. Sowter on the above subject for the pages of the NATURALIST in the near future.

Zoology—*Tunicata of the Pacific Coast of North America.*

1. Perophora annectens, n. sp. By WILLIAM E. RITTER. Proc. Cal. Acad. Sc., Vol. IV, Part I, pp. 36-85, Plates I. II. and III., figs. 1-39. Sept., 1894.

This is an interesting and exhaustive biological study of one of those interesting species of tunicates which abound along the rocky coasts and shores of the North American Pacific. The species here described for the first time is from Monterey Bay, California. The author gives first a general summary of our knowledge of simple and compound ascidians, and points out that with the result of his researches, the importence of this old classification becomes "*nil.*"

Perophora Hutchinsoni, from Australia, and *P. viridis* from the New England coast of North America are the latest forms brought under Wiegmann's genus established in 1835. Then follows a diagnosis of the species with a general description dealing with the mode of occurrence of the ascidiozooids in their colonies. Their histological characters are very ably described. This form is a particularly favorable one to study owing to its wonderful transparency. The *test* and the origin of its cells receives special attention. The results of Ritter's work confirm those of Salensky and Kowalevsky on the same subject, showing that the cells of the tunicate test are not derived from the ectoderm but from the mesoderm. Dr. Ritter says: "I believe this to be due to the fact that the cellulose substance of the test is here being formed. . I have no evidence that the matrix or cellulose portion of the test is produced as a secretion of the mesodermal cells imbedded in it . . . . . .

Selensky also regards the processes present as having to do with the formation of the cellulose substance."

The musculature, the pharyngeal apparatus, interesting notes on the parasites of the tentacles, the branchial basket proper, the endostyle, the sub-neural gland, the digestive tract and its parasites, each received a share of careful description. Then the reproductive and circulatory systems are discussed. The movements of the heart and the character of the blood cells are also noted, some new light being thrown on the latter although Roule has arrived at very similar results from his researches on the simple ascidians from the Coast of Provence, France. Three plates accompanying the paper. The figures were nearly all outlined by the author with the aid of an Abbé camera lucida.—H. M. AMI.

Zoology—VERRILL, A. E.—*Distribution of the Echinoderms of North-eastern America.*—Amer. J. Sc. & Arts, Vol. XLIX, 3rd Ser., No. 290, pp. 127-140, February, 1895, also *ibid*, No. 291, pp. 199-212, March, 1895, New Haven, Conn.

The following species of Echinodermata from Canada and other British possessions in North America are recorded in these interesting papers by Prof. Verrill.

ASTERIOIDEA.

No.	Genera & Species.	Author.	Locality.	Remarks.
1	Pontaster hebitus	Sladen	Nova Scotia and Newfoundland	Banks off the coast.
2	Pseudarchaster intermadius	Sladen	Nova Scotia	A circum-polar species.
3	Ctenodiscus crispatus	Dub. and Kor.	Bay of Fundy	
4	Psilaster Floreæ	Verrill	Banks off Nova Scotia	Taken by Gloucester fishermen.
5	Pentagonaster granularis	Perrier	Banks off Nova Scotia	Taken by Gloucester fishermen.
6	Hippasteria phrygiana	Agassiz	Bay of Fundy, Nova Scotia	On hard bottoms.
7	Tremaster mirabilis	Verrill	Banks off Nova Scotia and Newfoundland	
8	Solaster endeca	Forbes	Bay of Fundy, banks off Nova Scotia	In 40 to 150 fathoms.

ASTEROIDEA—*Continued.*

No.	Genera & Species.	Author.	Locality.	Remarks.
9	Solaster Syrtensis..	Verrill......	Banquereau, Nova Scotia................	45 to 80 fathoms.
10	Solaster Earllii.... (allied to S. Dawsoni Ver. from coast of Brit. Col.	Verrill.... .	Banks off Nova Scotia and Newfoundland....	From 170 to 300 fathoms.
11	Cros aster papposus	Müll and Troschel ..	Bay of Fundy, Newfoundland	An arctic species.
12	Pteraster pulvillus.	M. Sars....	Bay of Fundy, banks off Nova Scotia and Newfoundland..........	
13	Pteraster militaris..	Müll and Troschel ..	Bay of Fundy.........	Common, 10 to 50 fathoms.
14	Cribrella pectinata	Verrill......	Bay of Fundy.........	Shallow water.
15	Cribrella sanguinolenta.... ...	Lütken.....	All along the eastern coast	On hard bottoms, ranges to Greenland.
16	Pedicellaster typicus	M. Sars ...	Gulf of St. Lawrence...	Ranges to the Arctic Ocean.
17	Stichaster albulus..	Verrill......	Bay of Fundy, and off coast of Nova Scotia..	Common, ranges to Greenland.
18	Asterias vulgaris...	Stimpson MSS.....	Bay of Fundy, Labrador.	Belongs to the cold areas.
19	Asterias stellionura	Perrier.... .	Banks off Nova Scotia..	40 to 300 fathoms.
20	Asterias enopla.... (a new species)	Verrill......	Off Nova Scotia.......	53 to 100 fathoms.
21	Asterias polaris....	Verrill......	Anticosti, Gulf of St. Lawrence, Labrador .	Large and abundant on she Labrador coast.
22	Leptasterias tenera.	Verrill......	Bay of Fundy, Newfoundland	Possibly L. Compta
23	Leptasterias Groënlandica	Verrill.. ...	Gulf of St. Lawrence, Bay of Fundy........	Ranges to the Artic Ocean.
24	Leptasterias littoralis...........	Verrill......	Coast of Nova Scotia, Gulf of St. Lawrence..	
25	Hydrasterias ophiodon...........	Sladen.. .	Off Halifax...........	Collected in 1,250 fathoms by the "Challenger."
26	Odinia Americana.	Verrill.	Banquereau, Nova Scotia....	Attains a great size.

H. M. A.

CLUB NOTES.

Annual Meeting At the Annual Meeting of the Ottawa Field Naturalists' Club held on Tuesday, March 19th, 1895, the following members were present: Dr. G. M. Dawson, C.M.G., F.R.S., president, in the chair; Dr. R. W. Ells, Messrs. R. B. Whyte, W. Hague Harrington, T. C. Weston, A. G. Kingston, Walter R. Billings, T. J. MacLaughlin, Frank T. Shutt, D. B Dowling, Maurice Panet, R. H. Campbell, Andrew Halkett and H. M. Ami.

The Sixteenth Annual Report of Council for 1894-95, was read by the Secretary, Dr. Ami, and showed that the Club was in a flourishing condition.* The following were then elected members of the council for 1895-96, to which is added the name of the patron of the club, the standing committees of Council and leaders.

Patron:

THE RT. HONOURABLE THE EARL OF ABERDEEN,
GOVERNOR-GENERAL OF CANADA.

President:

MR. F. T. SHUTT, M.A., F.I.C.

Vice-Presidents:

Mr. A. G. Kingston. Dr. H. M. Ami, M.A., F.G.S.

Librarian:

Mr. S. B. Sinclair, B.A.
(Normal School.)

Secretary:

Mr. Andrew Halkett.
(Marine and Fisheries Dept.)

Treasurer:

Mr. D. B. Dowling, B.A.Sc.
(Geol. Survey Dept.)

Committee:

Prof. E. E. Prince, B.A., F.L.S.
Mr. James Fletcher, F.L.S., F.R.S.C.
Mr. W. F. Ferrier, B.A.Sc., F.G.S.
Miss A. Shenick, B. Sc.
" G. Harmer.
" A. M. Living.

Standing Committees of Council:

Publishing: Dr. Ami, Prof. Prince, Mr. Dowling, Mr. Kingston, Mr. Ferrier.
Excursions: Mr. Kingston, Mr. Dowling, Dr. Ami, Miss Shenick, Miss Living.
Soirees: Prof. Prince, Mr. Sinclair, Mr. Fletcher, Mr. Halkett.

Leaders:

Geology: Dr. Ells, Mr. Ferrier, Dr. Ami.
Botany: Mr. Whyte, Prof. Macoun, Mr. Craig.
Entomology: Mr. Fletcher, Mr. Harrington, Mr. MacLaughlin.
Conchology: Mr. Latchford, Mr. Halkett, Mr. O'Brien.
Ornithology: Mr. Kingston, Miss Harmer, Mr. Lees.
Zoology: Prof. Prince, Mr. Whiteaves, Mr. Small.

Excursions—The Excursion Committee and Council of the Club have before them an interesting series of excursions for the summer. The first general and spring excursion of the Club is to take place on the afternoon of **Saturday**, the **18th** of May, when **Chelsea**, on the outskirts of the Laurentide Hills, will be visited. It is needless to describe

*Full report published in the April number of the OTTAWA NATURALIST, pp. 15 to 18.

the attractive features of the locality. Leaders in Botany, Geology, Entomology, Ornithology etc., will be present and a profitable as well as an enjoyable time is expected. The excursion (special) train will leave the **C.P.R.** (Union) **Station,** Ottawa, at **1.30** p.m., returning, leave Chelsea at **6.30** p.m. Full round trip **tickets** can be obtained from members of the Excursion Committee or of Council at the station or previously—at the following rates :

Members - - - -	30 cents.
Non-members - - - -	40 "
Children - - - -	half price.

Sub-excursions—At a joint meeting of the Council and Leaders of the Ottawa Field Naturalists' Club, held in the Normal School, 26th April, 1895, it was unanimously agreed "That sub-excursions be arranged for Saturday afternoons, as in former years. Sub-excursion parties will assemble at the **City Post Office** beginning Saturday, **May 4th,** at **2.15 p.m.** sharp—where leaders in different branches of the Club's work will be in attendance. Interesting localities within easy reach of the electric car system will be visited, and special opportunities afforded to those who desire to study the **flora** and **fauna** of Ottawa and its environs.

Fees—The new Treasurer elect, Mr. D. B. Dowling, Geological Survey Department, Ottawa, calls the attention of the members of the Club to the date which he has taken the trouble to place on the address slips informing each member of the time of expiring of his or her subscription. As the **Naturalist** cannot be published without funds, a prompt payment of the fees now due by members of the Club, will enable the publishing committee to carry on its work with greater facility and success. Membership fee, comprising subscription to **Ottawa Naturalist,** only **one dollar.**

The Ottawa District—For purposes of Natural History and for more exactly defining the limits of the phrase "Ottawa District," it was unanimously agreed at the last Council meeting of the Ottawa Field Naturalists' Club to limit the territory included, to that which is comprised within a circle whose centre is **Ottawa,** with a radius of **thirty miles.**

Meteorological Observations—The members of the Ottawa Field Naturalists' Club are particularly indebted to Mr. R. F. Stupart, the new Superintendent of the Dominion Meteorological Service at Toronto, for a most valuable abstract of observations which we publish in this number of the NATURALIST.

Ottawa Camera Club—At the first meeting of the Council of the Ottawa Field Naturalists' Club, held since the annual meeting, it was unanimously agreed to extend an invitation to the members of the OTTAWA CAMERA CLUB to attend our excursions at reduced members' rates.

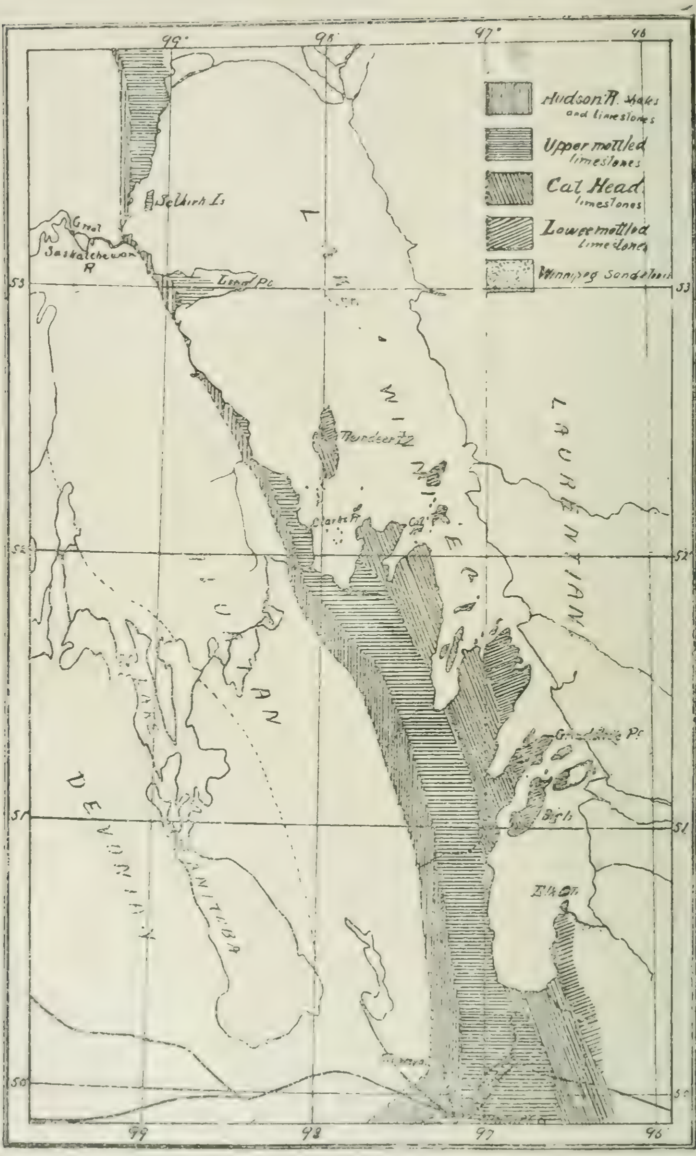
Frequency of the Different Winds from Observations at 7 a.m., 2 and 9 p.m., Ottawa, 1894.

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
January	7	9	23	0	3	5	22	8	16
February	2	3	17	0	8	12	12	10	20
March	6	6	14	5	6	13	23	9	11
April	9	8	12	5	11	9	16	5	15
May	8	9	13	7	15	10	9	10	12
June	3	3	8	3	11	21	24	8	9
July	4	4	4	3	13	21	16	5	23
August	17	6	7	6	8	15	8	12	14
September	1	4	12	7	11	10	16	6	23
October	1	8	20	7	9	15	20	5	8
November	7	4	17	4	8	11	24	10	5
December	5	3	23	2	8	16	16	12	8
Year	70	67	170	49	111	158	206	100	164

Heaviest snow storm of year, 29th January. Amount, 22 inches.
Coldest day of year, 24th February. Mean Temp., 13.85.
Last snow, 24th March.
First thunder storm, 4th April.
Last Frost, 15th April.
Heaviest rain storm of year, 20th June. Amount, 1.64 inches.
Warmest day, 19th July. Mean Temp., 77.80.
First frost of season, 26th September. Thermometer, 29.5.
First snow of season, 14th October. Not measurable.
Last thunder storm, 16th October.
First measurable snow, 5th November. Amount, 1.5 inches.
First record below zero, 26th December.

Abstract of Meteorological Observations at Ottawa for the Year 1894.

	MONTH.												YEAR.
	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
Average height of barometer at 32 and reduced to sea level	30.170	30.162	30.048	30.076	29.951	29.930	29.978	30.022	30.076	29.946	30.045	30.125	30.044
Highest barometer	30.808	30.908	30.461	30.486	30.420	30.265	30.318	30.232	30.587	30.322	30.849	30.642	30.908
Lowest barometer	29.450	29.586	29.488	29.580	29.472	29.417	29.053	29.740	29.585	29.227	29.412	29.457	29.227
Monthly and annual ranges	1.358	1.322	0.973	0.906	0.957	0.848	0.664	0.492	1.002	1.095	1.437	1.185	1.681
Average temperature of air (Fah.)	12.97	11.09	31.20	45.99	55.46	65.05	68.03	61.79	59.65	47.31	29.43	21.33	42.51
Difference from average	+2.03	1.34	+8.30	+8.21	0.00	+0.25	-1.09	-5.69	+1.75	+2.71	-2.37	+4.22	+1.55
Highest temperature	41.0	38.5	54.2	73.4	83.8	91.0	93.0	89.6	82.3	65.5	51.6	45.8	93.0
Lowest temperature	10.2	-25.7	3.5	13.0	35.5	36.2	47.0	42.0	29.5	33.8	1.5	-24.5	25.7
Monthly ranges	57.2	64.2	50.7	60.4	48.3	54.8	46.0	47.0	52.8	31.7	50.1	70.3	118.7
Average maximum temperature	22.76	21.73	38.66	57.01	65.89	76.44	79.80	73.30	71.38	55.55	55.65	27.86	118.7
Average minimum temperature	2.97	-0.50	23.37	35.20	44.90	55.60	58.05	51.84	49.54	40.97	23.05	13.55	118.7
Average daily range	19.79	22.23	15.30	21.81	20.98	20.75	21.71	21.46	21.84	14.59	12.61	14.31	18.05
Average pressure of vapour	0.076	0.073	0.167	0.242	0.298	0.251	0.519	0.405	0.417	0.276	0.133	0.113	0.270
Average humidity of the air	83	83	90	74	67	78	73	72	79	83	76	85	79
Average temperature of dew point	12.4	10.7	30.0	39.4	44.9	60.2	60.1	53.1	53.9	42.8	24.7	21.0	79
Amount of rain in inches	0.55	0.03	1.05	0.77	3.46	5.36	3.57	1.46	2.01	3.60	1.40	0.48	23.74
Difference from average	0.20	0.37	0.11	0.81	+1.10	+1.35	+1.10	-1.77	-0.59	+0.90	0.04	0.18	+0.39
Number of days of rain	5	1	8	3	15	12	16	9	11	14	6	4	100
Amount of snow in inches	33.0	6.5	6.0	.....	.....	.....	.....	.....	.....	*	9.5	15.0	70.0
Difference from average	+10.8	-16.7	-8.7	-5.2	*	.....	.....	.....	.....	-1.0	-0.1	-8.6	29.5
Number of days of snow	15	11	7	.....	.....	.....	.....	.....	.....	1	11	13	58
Percentage of sky clouded	59	63	63	47	56	59	46	66	63	68	78	73	62
Number of days completely clouded	6	5	5	2	4	4	1	3	5	6	11	11	63
Average velocity of wind (mile)	7.29	7.85	7.75	7.42	7.23	4.90	4.35	4.55	4.64	7.11	8.88	8.89	6.74
Number of auroras	0	2	1	2	0	1	0	1	1	0	1	0	9
Number of thunder storms	0	0	0	2	2	3	6	3	1	1	0	0	18
Number of fogs	0	1	1	0	0	0	0	1	1	2	0	0	9



Sketch Map of Lake Winnipeg,
Showing Sub-divisions of the Cambro-Silurian of Eastern Manitoba.

THE OTTAWA NATURALIST.

VOL. IX. OTTAWA, JUNE, 1895. NO. 3.

NOTES ON THE STRATIGRAPHY OF THE CAMBRO-SILURIAN ROCKS OF EASTERN MANITOBA.

By D. B. DOWLING, B. A. Sc..

(By permission of the Director of the Geological Survey.)

Along the western edge of the great Archæan area which lies north and west of Lake Superior, stratified deposits are found lying unconformably on the irregular surface of these older rocks.

As early as 1819 they were recognized by Sir John Richardson, who accompanied Sir John Franklin on his overland expedition, to be similar in age to those of the Black River formation of eastern Canada. Numerous papers have since been published on observations made in other localities, and prominent among these is the report by Prof. H. Y. Hinde, of the Saskatchewan Exploring Expedition. The general conclusions from all these reports and papers is, that there is a definite series found in the district, which represents the Hudson River formation, but the beds in the lower part of the section have become rather confused, owing to a lack of definite knowledge as to their sequence.

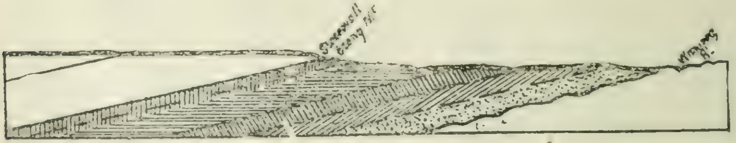
During the seasons of 1890 and 1891, Mr. J. B. Tyrrell, with the writer as assistant, was engaged in a survey of the geological features of Eastern Manitoba, having special reference to the exposures of the rocks on the shore of Lake Winnipeg. A part of the writer's duties consisted in making an examination of the exposures on the islands and western shore of the lake, in order to follow as closely as possible, the sequence of beds and determine the probable thickness and extent of the formation. The present paper is intended to give in outline, the field relations of the several exposures visited and examined by either Mr. Tyrrell or the writer. A full detailed account will be found in the forthcoming Report by Messrs. Tyrrell and Dowling in the Annual Report of the Geological Survey Department.

The fossil remains collected from these beds have shown many new forms, and many of them have already been described by Mr. Whiteaves the Palæontologist of the Survey. But apart from the palæontological evidence, which, so far, is not very definite, the series might provisionally be divided under the following heads, on purely lithological distinctions.

Hudson River Shales consisting of reddish and yellowish limestones, dolomites and shales.

Upper Mottled Limestones, Magnesian limestones.
Cat Head Limestones, fine grained cherty limestones. (Magnesian.)
Lower Mottled Limestones, very similar to the upper mottled.
Winnipeg Sandstones, friable sandstones with shaly bands.

These several divisions are represented on the accompanying sketch map and section, and are seen to be exposed in regular sequence from the lowest beds on the east, to the highest on the west. The whole formation seems to have a slight dip, south of west which is seen on Lake Winnipeg very plainly, by following the division between the sandstone, and the overlying limestone beds. This line is quite distinct, and the several measured sections in which it occurs, when plotted, show that the surface of the sandstone or lower face of the limestone, instead of being a plane, is gently undulating or waved, the distance between the crowns of the undulations being from eight to sixteen miles, while the variations in height run somewhere near twenty feet. The direction of the axis of the folds is with the dip towards the W.S.W., so that the intersections of this crumpled plane, with the horizontal one of the lake, forms a waving line, extending from Elk Island northward to near Dog Head.



SKETCH SECTION THROUGH STONEWALL, E.N.E., TO THE WINNIPEG RIVER.*

The floor on which these rocks were laid is the uneven surface of the Archæan rocks, seen on the eastern side of the lake. In the

*For index of shading see sketch map accompanying this paper.

southern portion, the general inclination of this uneven floor, is possibly about parallel to the bedding of the overlying series, but farther north it is more abrupt, as at Dog Head, where a narrow channel has been eroded, and is kept free by currents in the lake, through the soft underlying sandstone, a depth of 112 feet has been reached at a little over one half mile from the Archæan rocks of the east shore.

THE WINNIPEG SANDSTONE.

The basal beds of this series of Cambro-Silurian rocks, is, on its eastern outcrop, a sandstone, which is probably a shore deposit of an advancing sea, and therefore, not altogether similar in age, to those to the south, at the base of the Cambro-Silurian in Minnesota, but may possibly be a trifle later. The fossils found, so far, are rather indefinite, and would seem to be much the same as species in the next overlying series of limestones. Mr. Whiteaves, the paleontologist of the Geological Survey, intends making a study of these in the near future. The exposures on the lake show a thickness of about 100 feet of friable fine grained sandstone with a few feet of dark grey green shales toward the upper part of the section. The lower half resting on the Archæan, is seen on the eastern end of Punk Island as a pure, clean fine-grained sandstone, lightly cemented, and very friable. In several places it is somewhat harder, and of a reddish colour, from a staining of iron oxide, derived from the Huronion beds immediately underlying portions of the island. On Deer Island, to the west of this, the upper part of the sandstone is seen, overlaid by limestone. The sand is interbedded with shaly bands, and the sections exposed at several points, show an irregularity in the deposition of this dark material. The sections of this sandstone and shale at the several localities on the lake are all near the eastern edge of this deposit, and probably near the ancient shore line.

Comparisons with sections elsewhere made in Manitoba in drill holes, show an increasing deposit of the shaly beds in the upper part of the sandstone. For example, at Selkirk, the drilling extended 36 feet below the limestone, through shales and soft rocks, before striking a porous layer of pebbles and sand. Again at Rosenfeld,* a much greater

*On certain borings in Manitoba and the Northwest Territories by Dr. G. M. Dawson, Trans. Royal Society of Canada, Vol. IV, Pt. IV, 1886.

distance from the eastern outcrop, 75 feet of shale is recorded above the sandstone, which is there, 50 feet in thickness, thus it is probable that these shales were being deposited at the same time as the upper part of the Winnipeg sandstones. The localities at which examples of these sandstones may be seen are, Elk Island, Black Island, Deer Island, Punk Island, the shore from Little Grindstone Point to Grindstone Point, the shores near Bull Head, and the lower part of the cliffs near Dog Head.

LOWER MOTTLED LIMESTONE.

Just above the sandstone, horizontal beds of thin bedded mottled limestone form the principle part of the sections at Grindstone Point, Dog Head, Black Bear Island, Tamarack Island., Jack Head Island, and Swampy or Berens Island. The section given by these several exposures amounts to over 70 ft. The lowest beds are those seen at Deer Island and Grindstone Point, capping the sandstone. Immediately above are the beds occuring at Dog Head. followed by the upper part of the Black Bear Island exposure. Those on Tamarack and Jack Head Islands are evidently higher, but belong to the same series, and form, altogether, a section of 65 feet. To the north of this line of section, on Swampy Island and Little Black Island, just to the west, small cliffs of this same mottled limestone occur. The upper part of the cliff on Little Black Island seems to be more fossiliferous than those previously seen, and are probably not represented in the foregoing section, or fill the gap between the Tamarack Island and Jack Head Island sections. This might possibly add a few feet to the total given there, making a total thickness for this series of 70 feet. The character of the beds in this division is quite uniform and varies only in a slight degree in color. The lowest beds are somewhat darker and contain more earthy impurities, but they all have similar fucoidal markings on the surfaces of beds and through the section dark brownish streaks and blotches of finer grained material. The mass of the rock is made up of the debris of shells, etc., many very badly preserved. At Grindstone Point examples of a large cephalopod, probably a *Poterioceras*, have been partially preserved in a vertical position so that frequently slabs of the thin bedded limestone contain sections of the body chamber over

12 inches in diameter. These break out readily, forming circular discs much resembling crude grindstones. The name for this prominent point on the lake may possibly have been derived from the finding of these "grindstones" on the shore as well as from the fact of there being there the material (sandstone) from which grindstones could be manufactured.

CAT HEAD BEDS.

Above the lower mottled limestone are seen several sections of a fine grained evenly coloured yellow dolomitic limestone with numerous concretions of dark coloured chert filling cavities, apparently left by the decay of corals or soft bodied animals. Examples of these beds are seen in the high cliff at Cat Head and along the shore to Lynx Bay. At the western end of the section three miles west of Cat Head the cherty concretions attain large dimensions. Several are over a foot in length and one measured 2 feet by 10 inches. The lower beds are fine grained, resembling lithographic stone and are very rich in fossil remains.

The total thickness of these beds, as observed on the lake, is 68 feet. This includes the top beds of Cat Head and Outer Sturgeon Island which are similar in colour but coarser in texture, becoming finely crystalline.

The area outlined on the sketch match is proposed as a diagram of the theoretical outcrop of these rocks, but owing to the mantle of drift exposures are not always to be had, thus in the southern part east of Selkirk no exposures of this series at the surface so far are known, but the existence of similar beds is shown below the Selkirk rock in the drilling made for a well at Selkirk. Similarly no exposures west of Big Island are known, but on the beach on the westward side south of Icelandic River numerous fragments of the fine grained rocks are found. On Fisher Bay loose fragments are found on the islands, but the shores are all low and there are no rock exposures. The south point of Reindeer Island is probably underlain by these rocks and fine grained yellow beds exposed at the base of cliffs on the mainland southwest of this island may probably also belong to this series. The eastern end of Long Point is covered with drift deposit, but near the northern end of the lake at the

"First" and "Second" "Rocky Points" the upper part of the Cat Head beds are plainly seen in the lower beds of the cliff.

UPPER MOTTLED LIMESTONE.

Just above the yellow limestone beds, referred to as the Cat Head beds, there is found a series of mottled limestones somewhat similar to the lower limestone member. At the north end of the lake the beds are very much harder and more dolomitic than farther south. The section there is evidently much thinner, as between the base of the cliffs at the first Rocky Point and the Silurian rocks at the mouth of the Great Saskatchewan there can be only a very thin section which must include not only the upper mottled limestone but the Hudson River shales, etc. Farther to the south the section is slightly altered, the lower beds of these mottled limestones resemble those to the north, but higher up in the section the beds become darker in colour and are there only impure earthy limestones which are evidently grading up to the shales of the overlying Hudson River series. These lower beds are to be found at a point about nine miles north from Clark's Point, while at Clark's Point are seen the upper earthy limestones which with those at the mouth of the Little Saskatchewan River, form the transition beds to the Hudson River shales. The top of the upper mottled limestones is thus somewhat similar in appearance and constitution to the lowest member of the lower mottled and the top beds of the latter to the lower beds the former. These upper beds are thus described by Dr. R. Bell* as they occur on the Little Saskatchewan :—

"At the head of the four mile rapid there is a small exposure of thinly bedded flat lying limestone; on the south side of the river and at the foot of the rapid, limestone interstratified with shale is seen on both sides of the river. It is of yellowish and greenish grey colour and has a magnesian character. I noticed a large obscure Orthoceras in one of the beds and collected a tolerably well preserved *Pleurotomaria* and a *Rhynchonella* resembling the Hudson River form of *R. increbescens* (Hall).

On the Fisher River the only beds seen are near the mouth and they appear to be near the base of the upper mottled limestones not far above the Cat Head beds. They are light coloured mottled limestones very much like those at East Selkirk and Lower Fort Garry.

*Report by Mr. R. Bell, Report of Progress, G.S.C. for 1874-5, pp. 38.

The exposures at the latter places have been frequently described and the building stone from these quarries has been largely used in constructions in Winnipeg, they are therefore well known. The principal difference between these beds and those of the lower mottled limestone consists in the very white nature of the lighter portions, as also the general soft or chalky texture of the uncrystalline particles scattered throughout the whole mass leaving chalk or lime marks on the hands after handling. The mottling is of a light brown and is in irregular patches, but so general as to affect the whole of the beds giving them a general yellowish tint. It dresses easily and makes very fine building and ornamental stone. The papers by Prof. Panton* and Mr. McCharles* give graphic and full details regarding this stone. As to the thickness of the formation here, we were at first obliged to depend on a calculation based on the known dip of the beds at Grindstone Point of about 50 feet in six miles—assuming, however, that this dip is approximately the same at the south, the thickness of the limestone below Selkirk would be the total dip given in about 30 miles or 250 feet. Since the field work was finished a well has been drilled for the fish hatchery at Selkirk West and the bottom of the limestone passed through was found at 262 feet. Deducting then the thickness of the lower beds seen on Lake Winnipeg leaves about 110 feet of the upper mottled rock of Selkirk. To this may be added about 20 feet for beds between Selkirk and Winnipeg of the transition type as at Clark's Point. There is a strong probability that the beds at East Selkirk and Lower Fort Garry are brought up by a small fault running east and west, very near the northern limits of the former.† The amount of the upthrow is very uncertain and we can assume that the main part of these exposures are to be added to the thickness given in the drilling. I would not hesitate therefore in calling the thickness of these beds down to the recognized yellow beds of the Cat Head type, at least 150 feet, making a total of 290 feet of the limestone series. To the north the upper

*Transactions No. 15, 20 and 27, Man. Historical and Scientific Society, Winnipeg.

†The foot-steps of time in the Red River Valley by A. McCharles, Transactions No. 27, Man. Historical and Scientific Society.

beds are found to decrease greatly in thickness and as noted before gradually thin out to less than one hundred feet north of the mouth of the Saskatchewan.

Farther to the south at Rosenfeld, the evidence of drilling gives a thickness of limestone, undoubtedly the same series, of 305 feet,* thus showing a slight tendency to increase in that direction.

HUDSON RIVER BEDS.

Under the city of Winnipeg, red, impure limestones are reached in drilling for wells. The surface of the underlying rock slopes very abruptly to the east, the depths at which it is found varying from 60 feet on the west, and under most of the city, but increasing suddenly to 112 feet at the outer end of Point Douglas.† This seems to be about the extent of these soft beds to the east. They extend west, and are to be found at Little Stony Mountain in an undisturbed state, capped by beds of an ashy coloured dolomite. The thickness of this part of the formation is indefinite, but part of the section has been recorded by Prof. Panton, from the exposure at Stony Mountain. Here the dolomite seen at Little Stony Mountain, appears at the surface on the top of the hill, dipping slightly to the southeast, showing a tilting up of the underlying beds, and a consequent break in the section between this place and Stonewall. The section recorded amounts to 110 feet.

‡"The following is a vertical section of the rock, as observed during the digging of a well at the southwest part, upon which the Provincial Penitentiary is located."

1—20 feet solid hard stone like that at the quarries.
2—4 feet thin layers of the same.
3—2 feet solid rock.
4—6 feet thin and broken.
5—8 feet yellowish rock, quite ochreous.
6—10 feet reddish layer, full of fossil shells.
7—60 feet, a mixture of yellow and red, containing some flinty material."

Between the top of the Stony Mountain beds, and those at Stonewall, where the rocks appear to be Niagara, there are no exposures, but at the latter place the section in the quarry seems to be very similar in

*Trans. Royal Society, Canada, Vol. IV. 1886.

†Transactions No. 27, Manitoba Historical and Scientific Society, Winnipeg.

‡Transactions No. 15, season 1894-5, Manitoba Historical and Scientific Society, Winnipeg.

some respects to the upper part of the Stony Mountain section, but the fossils found are quite distinct. They evidently belong to a higher horizon. The gap in the series is evidently made up of soft shaly beds with possibly some sandstone at the base of the Niagara.

The section given by Dr. G. M. Dawson for the Rosenfeld well* I would be inclined to interpret as passing through the equivalent of the Stonewall beds as well as the Hudson River, of Stony Mountain, referred by him to the Maquoqueta shales of Wisconsin, and would arrange part after the following :

7—limestone,	15 feet	Niagara.
8—red shale	5 feet	
9—grey shale	10 feet	
10—limestone	30 feet	
11—fine grey sandstone,	40 feet	
12—chalky limestone	30 feet	Hudson River of Stony Mountain.
13—red shale	160 feet	
14—cream colored limestone,	305 feet	Winnipeg limestone, Trenton and Galena
15—red shales	75 feet	Winnipeg sandstone and associated shales.
16—soft sandstone	50 feet	

This would leave the Hudson River section with a thickness of 190 feet, which is not far from the probable thickness in the southern part of the province as this formation thins out toward the north, and is not seen in the section on either the Little Saskatchewan or Great Saskatchewan rivers. If we had a series containing several successive beds of limestone, there would, in all probability, be something seen of it on the northwest shore of the lake, between Saskatchewan river and Selkirk Island, where we have the Silurian or Niagara beds, and the top of the upper mottled or Galena limestone. On the Little Saskatchewan the probable representative is in the shales recorded by Dr. Bell at the head of the four mile rapid. A summary, then, of the several beds could be placed in the form of a section, in decending order, giving the total thickness for the Cambro-Silurian of this district, as less than six hundred feet :

Cambro-Silurian	Hudson River Shales..........	190 feet
	Upper Mottled Limestone......	150 feet
	Cat Head Beds................	70 feet
	Lower Mottled................	70 feet
	Winnipeg Sandstone....	100 feet
		580 feet

*Trans. Royal Society of Canada, Vol. IV, 1886.

THE WELL AT SELKIRK.

In the spring of 1894, a supply of water for the Selkirk fish hatchery, other than that of the Red River, being required, a well was drilled and a supply obtained after penetrating three hundred feet. The first or upper part was through 97 feet of till, then to a depth of 264 feet in limestone, reaching a dark shale, in which sandy layers, containing gravel, gave a sufficient supply of water. The specimens obtained from the drilling, show that the limestone through which the drilling was made, consists in the upper half of semi-crystalline light yellow beds, similar in a great measure to those rocks exposed at Selkirk and Lower Fort Garry.

At a depth of 185 feet, or 88 feet below the top of the limestone, a series of beds about 9 feet in thickness, were called by the drillers, sandstone, but it is found from the specimens to be mostly a band of fine grained limestone, through which cherty masses are scattered. The percentage of silica is low, being under ten. Examples of this rock are very probably to be seen at Cat Head, on the west shore of Lake Winnipeg, where the cliff is of a fine yellow magnesian limestone, and the lower beds well pitted with small cherty concretions.

The specimens from the lower part of the limestone in the well, are all of a light colorued limestone, somewhat coarser in texture than at the middle of the section, and are, no doubt, similar to the limestone of the shores of the lake at Grindstone Point and Dog Head. The thickness from the cherty layer to the base of the limestone was 79 feet, or a trifle more than that measured on the lake.

EXCURSION No. 2., O. F. N. C.

Excursion to Galetta.—Arrangements are nearly completed for the Club's second Excursion, which will be held on SATURDAY afternoon, **15th June**, 1895. **Galetta,** a charming village on the Mississippi River, about thirty miles from Ottawa, along the Ottawa, Arnprior and Parry Sound Ry., is the place selected. This is one of the most interesting and newest localities visited by the Club, and collectors of plants, insects, shells, rocks or other objects of Natural History, will find Galetta a perfect treasure land. There is excellent fishing, besides interesting outcrops of crystalline limestone and many beautiful bits of woodland, forest and stream scenery for members of the **Camera Club.**

Rates, etc.—Excursion train with Naturalists', etc., leave at 1.30 p.m., reaching Galetta at 2.30 p.m., return at sundown. Members tickets, fifty cents: non-members, sixty cents; children, half-price. Tickets to be obtained at the station or from members of the Council or of the Excursion Committee.

THE ROYAL SOCIETY OF CANADA.

The **fourteenth** meeting of the **Royal Society of Canada** was held in Ottawa, May 15th, 16th, and 17th, under the presidency of Mr. J. M. Le Moine, of Quebec. The meeting was full of interest. A large attendance of fellows at the various sittings of the different sections for the reading of papers, coupled with an unusually large attendance and increased interest in the public lectures and entertainments, mark this meeting as one of the most successful in the history of the Society.

The four sections of **French Literature**, etc., of **English Literature**, of the **Mathematical, Physical** and **Chemical Sciences**, of the **Geological** and **Biological Sciences**, met in the Provincial Normal School. There were **thirty** titles and abstracts of papers to be read before these sections, according to the programme, viz: *six* in section I; *eight* in section II; *nine* in section III; and *seven* in section IV.

Of the papers read, the following fall more or less directly in line with researches carried on by members of the Ottawa Field Naturalists' Club, and are here noted:

1. The Geology of the proposed Ottawa Ship Canal. By R. W. Ells, LL.D., and A. E. Barlow, M.A.

The route of the proposed ship canal, via the Ottawa, the Mattawa and French Rivers, and Lake Nipissing, is of great interest, both from the geological and commercial standpoint. It furnishes a comparatively short waterway between the great lakes and the head of ship navigation on the St. Lawrence, and crosses, for several hundreds of miles, the great series of Laurentian or Archæan rocks, nearly at right angles to their strike. In the eastern portion of this Laurentian complex is included the typical area described by Sir William Logan as the Grenville series, which includes foliated and stratified gneisses, granites, syenites, crystalline limestone, anorthosites, etc. These extend westward along the Ottawa for nearly two hundred miles, while in the western part of the section, these characteristic rocks have given place to a great development of granites and syenites, in places, foliated, but frequently massive. From their characters, as seen both in the field and under the microscope, these latter are clearly intrusive, and in large part are more recent in age than the crystalline limestone and associated gneisses which they have replaced. Areas of Huronian rocks, known as the Hastings series, also occur, while the sedimentary formations from the Potsdam to the Utica, both inclusive, have an extensive development along the lower Ottawa, and occasional small outliers of fossiliferous limestone are seen in the vicinity of Mattawa, and on the islands in the eastern portion of Lake Nipissing. Heavy deposits of sand, gravel and clay also occur at various points along the several river channels, and form an important geological feature.

2. Note on the occurrence of Primnoa Reseda on the Coast of British Columbia. By J. F. Whiteaves.

P. reseda is a large tree-like Alcyonarian coral, which was known to Pallas and Linnæus more than a hundred years ago. On the eastern side of the Atlantic its

ascertained geographical range is from the Cape de Verde to the Polar Sea, and on the western side of that ocean a few specimens of it have been dredged in deep water in the Bay of Fundy ond on St. George's Banks, by the U.S. Fish Commission, between the years 1864 and 1872.

Hitherto it has not been recorded as occurring in the Pacific. In the fall of 1894, however, Mr. Otto J. Klotz, D.T.S., of this city, presented to the museum of the Geological Survey Department a fine specimen of a coral, collected by himself at Work Inlet, near Fort Simpson, B.C., which Professor Verrill has identified with this species. The specimen is upwards of three feet in height, and a little more than two feet in the maximum spread of its branches. Another specimen of *P. reseda* which is said to have been collected on the north coast of the Queen Charlotte Islands, has recently been given to Professor Macoun by Mr. C. F. Anderson, of Comox, V.I.

3. *Note on Tertiary Fossil Plants from the vicinity of the City of Vancouver, B. C. By Sir William Dawson, F.R.S., &c.*

The paper relates to a series of beds holding lignite and vegetable fossilss and estimated at 3,000 feet or more in thickness which occurs in the southern part of British Columbia, between Burrard Inlet and the United States boundary. These beds have been noticed in the Reports of the Geological Survey by Messrs. Richardson, Bowman, and by Dr. G. M Dawson, and are believed to be newer than the Cretaceous coal-measures of Nanaimo and Comox, and probably equivalent to the "Puget Group" of the United States geologists in the State of Washington.

Collections of the fossil plants have been made at various times by officers of the Geological Survey, who are mentioned in the paper, and more recently by Mr. G. F. Monckton, of Vancouver, who has kindly placed his material in the hands of the author, along with that previously entrusted to him by the Geological Survey.

The species contained in the several collections are mentioned in the paper, and are compared with those of the Puget group, as described by Newberry and Lesquereux, and with those of other localities in British Columbia and the United States. The conclusion as to the age of the flora is similar to that arrived at by Newberry for the Puget flora, or that it is equivalent to the Upper Laramie or Fort Union group. It thus intervenes in date between the Upper Cretaceous of Nanaimo and the Oligocene or Lower Miocene of the Similkameen district, already noticed in the Transactions of the Royal Society, and is therefore of Eocene age, filling a gap hitherto existing in the mesozoic flora of the West Coast.

Much undoubtedly remains to be known of this interesting flora, and as the formation containing it, which seems to be estuarine in character, extends over a wide area in British Columbia and Washington, and is of considerable thickness, more especially in its extension south of the Canadian boundary, it may prove to include several sub-divisions representing the long interval between the Cretaceous and the Middle Tertiary.

4. *Account of Investigations on the psychic development of young animals, and its physical correlation. By Prof. T. Wesley Mills, M.A., M.D., etc.*

The account of investigation on the psychic development of young animals and its physical correlation, which was begun last year in a paper on the Dog, will be continued in a series of papers, to be presented at the meeting of this year. These will embrace reports of investigations on: I. The Mongrel dog, and the Mongrel and the pure-bred dog compared. II. The Cat. III. The Dog and the Cat compared. IV. The Rabbit and the Guinea Pig. V. Birds.

In these papers the same plan will be followed as in the paper on the Dog presented to the Society last year, *i.e.*, after an introduction there will follow a diary or daily history of progress in development, and final remarks on the latter, with some of the main conclusions to be drawn from the facts stated in the diary. An attempt will be made throughout to correlate physical development with psychic development.

5. *Organic Remains of the Little R. Group, No. 4. By G. F. Matthew, D. Sc.*

This is a short article describing the remainder of the air-breathers, so far known, from the Plant Beds of the Little R. Group, to consist of one Insect, three Arachnids, and one Crustacean.

The insect is a wingless one belonging to the order Thysanura, and is related to the modern Springtails. No similar insect of anything like such great antiquity has been known hitherto.

Only one of the Arachnids is sufficiently well preserved to give a fair idea of the structure of the animal; in the other two only the abdomen is preserved. The most complete of these Arachnids is something like Anthracomartus of the coal-measures, but has a wider and shorter cephalothorax.

The crustacean described is *Amphipeltis paradoxus*, Salter, which is referred provisionally to the Isopods.

6. *Note sur l'ouvrage de J. Cornut, intitule: "Canadensium Plantarum Historia. Par Mgr. J. K. Laflamme.*

Valeur scientifique de cet ouvrage. Par qui les plantes étudiées par Cornut ont-elles été transportées du Canada en France? Et, comme la plupart ont été décrites d'après des échantillons vivants; où Cornut a-t-il vu ces échantillons!

7. *Some Variations in Epigæa repens. By Mr. G. U. Hay.*

8. *The Chemical Composition of Andradite from two localities in Ontario. By Prof. B. J. Harrington, B.A, Ph.D.*

The paper gives the results of the examination of a black garnet, (**Andradite**) which occurs in association with the magnetic iron ore of the "Paxton Mine." Lutterworth, Ontario; and also of a brown andradite which is present in the Nepheline Syenite of Dungannon. The first was found to be free from titanuim, while the latter is titaniferous.

9. *The Present Position of American Anthropology. By Prof. John Campbell, LL.D.*

10. *On the Estimation of Starch. By Thomas Macfarlane, Chief Analyst of Canada.*

11. *Viscosity in Liquids, and Instruments for its Measurement. By Anthony McGill, M.A. Presented by Mr. Macfarlane.*

NOTES, REVIEWS, AND COMMENTS.

Entomology.—Ormerod, Eleanor A. F. R. Met. Soc., etc. Report of Observations of Injurious Insects and Common Farm Pests, during the year 1894, with Methods of Prevention and Remedy. Eighteenth Report,

Our illustrious Corresponding Member gives evidence in this very valuable report, of her continued devotion to the study of Economic Entomology, and of her excellent ability to clearly describe the results of her investigations. A large number of the more injurious insects are treated of at considerable length, the report consisting of 122 pages

and an appendix of 62 pages, on the Warble Fly or Ox Bot fly, besides index, etc. A very interesting chapter deals with the development and injuries of four species of Eelworms, or Threadworms, and the account of a serious attack of certain Ground-beetles, or Carabidæ, upon strawberry plants, is most interesting, because insects of this family are, in general, predaceous in their habits, and beneficial rather than obnoxious.

The Caterpillars of two moths are described as apple pests, and that of a butterfly, as attacking cherry. Currants suffered from the attacks of the moth, *Sesia tipuliformis*, which is also injurious to this plant in Ottawa, and the Red Spider infested the gooseberry. Mangolds suffered from Millepedes of several species, and turnips from insects belonging to several orders. It is regretted that a fuller synopsis cannot be given of this admirable report, which will add to the reputation already gained by the author for reliable and thoroughly scientific work.—W. H. H.

Ornithology.—A WELL MARKED BIRD WAVE.—The White-crowned Sparrow (Zonotrichia leucophrys) is a sparrow which generally keeps well together in its northward migration, the interval between the first and last observed individuals seldom covering more than 10 or 12 days, during the whole of which their pretty mating ditty can be heard almost hourly. This year the advance guard reached this region during the warm spell which made the second week in May seem so much like July. The first record was made on the 6th, and stragglers were seen up to the 11th, when the sudden drop in the temperature repulsed them wholly. Not a Whitecrown was seen or heard—except a solitary one on the 16th—until Sunday, the 20th, when with a slightly warmer and hazy weather, they suddenly re-appeared in full force. On Sunday, Monday and Tuesday they literally swarmed about the gardens and weedy vacant lots. Their song could be heard incessantly as long as daylight lasted. Even the House Sparrows were outnumbered, and their pugnacity overawed. The two species could be seen feeding peacefully side by side, the first instance, perhaps, of any native bird establishing a *modus vivendi* with this little bully.

In a solid body as they came, the White-Crowns appear to have passed on to their northern breeding grounds: on Wednesday, the

22nd May, two or three only were observed and since that none. The genus is represented here in summer by the white *throated* Sparrow or Peabody bird (Z. albicollis) whose full, pure song "Old . . . . Tom . . . . Peabody, Peabody, Peabody" rising from ravine or moist thicket, is so familiar all summer long. Another rendering common in the Gatineau country is "Jim . . . Jim . . . Sow-the-wheat, sow-the-wheat, sow-the-wheat. The song of the White-Crown while bearing some family resemblance to this, has not the same clearness and fulness of tone, but approaches nearer to that of the Vesper and Savanna sparrows.

A. G. KINGSTON.

Natural Science Association, Iroquois.—The Natural Science Association, in connection with the High School, at Iroquois, Ont., has, of late, come into immediate touch with several members of the Ottawa Field Naturalists' Club. This association has for its object* "the encouragement of original scientific investigation and mutual assistance in the study of the Natural Sciences, by discussions, lectures, papers, and critical readings from scientific authors, and by the supply of such periodicals, magazines, etc., as shall be deemed advisable." During the past winter a very interesting and instructive programme has been carried out. The association is really alive to the fact that natural science studies help in developing the mental, moral, as well as the spiritual and even the commercial side of man. The following are the officers of the Association:

Honorary President, ARTHUR FORWARD, B.A.; *President*, J. A. JACKSON, B.A.; *Vice-President*, MARY MCGINN; *Secretary*, JAMES WARREN, B.A.; *Treasurer*, DAVID COLLISON; *Science Master*, R. H. KNOX, B.A.; *Councillors*, HERBERT DONNELLY, CYRUS MUNROE, CARRIE MOORE; *Curator*, GEORGE CLARKE; *Patrons*, JOHN HARKNESS, M.D., H. H. ROSS, M.A., M.P., W. A. WHITNEY, M.A.

*Sect. 1, Part 3, of the Constitution. Iroquois Nat. Sc. Assoc.

Excursion No. 1.—As announced, the first field day of the O.F.N. Club for the season of 1895 was held on Saturday, 18th May. It has generally been found that the country lying immediately south of the first range of the Laurentides shows the effects of advancing spring earlier than any other portion of the *Ottawa district* and consequently some point in that neighbourhood has always been in favour for the May excursion.

This year Chelsea was chosen. A special train on the Ottawa and Gatineau Railway, starting at 1.30 p.m., carried nearly 200 members of the club and their friends. By invitation there were present several members of the Royal Society of Canada, the annual meeting of which had closed on the preceding day, as well as a large contingent of the Ottawa Camera Club and of the students of the Provincial Normal School. Upon reaching Chelsea, about 2 o'clock, the party, as usual, divided into several sections, each accompanying its own leader to the point of greatest interest in some favourite branch of natural history. The Geological section under Dr. R. W. Ells visited Old Chelsea and a mica mine on the mountain side above that little village. The Botanical and Entomological sections under Mr. Jas. Fletcher and Mr. W. H. Harrington took the woods in the direction of the Gatineau; while the rocky gorge of that river and the picturesque rapids above Messrs. Gilmour & Hughson's mills attracted most of the members of the Camera Club.

Everywhere, vegetation, even the native plants and trees, showed unmistakable signs of having suffered from the recent severe frosts, following the treacherously warm spell of the 5th to the 11th May.

The afternoon, though breezy, was pleasant; but unfortunately the hour set aside for the examination and remarks of the leaders upon the specimens collected was marred by a slight rainstorm. Many of the party sought the shelter of the cars, but a fair audience braved the weather on the open platform of the station, where short addresses were delivered by Dr. A. R. C. Selwyn, president of the Royal Society, Prof. Goodwin, of Queen's University, and Mr. Kane, of St. John, N.B.

The botanical specimens collected were then named and commented upon by Messrs. R. B. Whyte and J. Craig, the insects by Mr. J. Fletcher and the rocks and minerals by Dr. Ells.

The party returned to Ottawa about 7 p.m.

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CILIA.

By PROFESSOR EDWARD E. PRINCE, Dominion Commissioner of Fisheries, Ottawa

Anyone who has watched the minute organisms, seen in a drop of pond-water under the microscope, must have been struck by the extremely active motions of many of them. Simple in structure, and destitute of limbs, they rush across at a furious rate, or glide smoothly and swiftly in serpentine fashion, or spin round and round in endless gyrations. How are these astonishing movements produced? They are due to cilia, the simplest and most insignificant of all organs of locomotion. These organs are widespread in the animal kingdom, though, curiously enough the Arthropods, that large class of animals embracing crustaceans, insects, spiders, centipedes, etc., do not possess them, so far as naturalists have been able to ascertain. As a rule they are very small and abundantly scattered, but they may be few and of considerable length, when they are then distinguished as flagella, not cilia. A flagellum and a cilium are, however, structurally and functionally the same. Flagella occur in plants as well as in animals, and the spores of some algae are so active, when swimming about, that they may be readily mistaken for minute infusorian animalcule. Certain bacilli, too, possess one or more flagella, and like the Monads, the lowliest of all animal organisms, are able to progress with considerable speed. *Noctiluca* is a remarkable flagellate animal, like a small particle of jelly. It swims through the water by means of its lashing flagellum, and it often occurs in such countless myriads at the surface of the sea, that being phosphorescent and able to admit light, the waves are brilliantly illuminated over considerable areas. In contrast to *Noctiluca*, we find that in *Paramœcium*, the commonest of ciliated infusorians, minute cilia occur thickly all over the surface of the body.

and extend even into the funnel-shaped mouth. *Noctiluca* is a good example of a flagellate creature. *Paramæcium* is a type of a ciliated animalcule. In the latter the cilia serve not only to drive the creature about, they carry food into its mouth. They perform this latter function also in the bell shaped *Vorticella*, and in *Stentor*, the trumpet animalcule. These microscopic animals are rooted by a stalk, and the circle of cilia, around the mouth-opening, sweeps in floating particles of food. When *Vorticella* becomes detached the cilia, at once, carry it swiftly about from point to point. Cilia, again, are chiefly food-carriers in those lowly animal forms, the sponges. The substance of a sponge is traversed by channels provided with waving cilia. While carrying in food and aiding nutrition the cilia assist in respiration by maintaining a constant circulation of water. Nutrition and respiration are also accomplished in aquatic mollusca by means of cilia. The river mussels, for example, inhale constant streams of water. These streams are produced by the countless cilia, with which the gills are covered. If a fragment of a gill be torn off the cilia immediately carry it through the water most vigorously. The intestine in these molluscs is also ciliated, and in the pond snails the tentacles and various parts of the body are richly so. Again, among the zoophytes cilia though present are of inferior importance. They stud the crown of tentacles and line the digestive tract, just as they do in certain worms, notably the tube-building species. In such marine annelids as *Terebella*, the gills, cirri, and tentacles, which form a crown around the head of the animal, are ciliated and it has been observed that, when the tube is being built, particles of sand and mud are driven along the tentacles to the protrusible proboscis by means of these cilia. The branchial cilia aid in respiration.

While some worms are non-ciliated, others are so abundantly clothed with them, that the surface of the body exhibits a constant shimmering appearance. Certain ciliated patches subserve sensory functions, such as smell, etc., but the excretory or "segmental" organs, characteristic of the Vermes, always possess a ciliated canal for ensuring the outflow of waste products. The digestive tube also in these creatures is observed to be lined with cilia, in most cases.

Important, however, as cilia are, in adult stages of the animals referred to, they are not of inferior importance to the newly hatched young. Sponges, starfishes, zoophytes, jellyfish, worms, etc., pass through a ciliated larval condition, with rare exceptions, and the cilia as in the active Infusorians aid in progressive locomotion.

It might appear that in the highest animals, provided with special limbs for locomotion and with complicated respiratory and digestive organs, there is no necessity for cilia. It is not so. They are often of importance in the Vertebrates, although sometimes they may be found to persist, when the necessity for them has apparently gone. Thus Amphioxus, the lowest of fishes, possesses a ciliated skin, in the young condition. Larval lampreys, too, exhibit delicate hairs upon the external integument, a remnant no doubt of the ciliated condition, though the hairs are now rigid. The usefulness of such cilia and bristles is difficult to discover. Similarly, the cilia which line the gullet in newly-hatched fishes, such as the haddock, have no doubt merely an ancestral meaning. No food passes down the gullet, for the creature is mouthless and subsists by absorbing the contents of the yolk-sac. The cilia soon disappear, though in many Vertebrates, such as the the frog, the mouth, throat, air-passages, stomach, etc., are ciliated through life. Nor are they absent from the highest animals, but even in man, they occur in the nasal passages, the respiratory tubes, certain auditory canals, the secretory ducts in the tongue and many organs, the ovarian passages, and other cavities; but their use now appears mainly to be the expulsion of matters hurtful to the sensitive epithelial surfaces referred to. The central canal in the human spinal cord is lined by ciliated cells in childhood, but these cells are obliterated later. We thus see how important is the part played by these minute and insignificant organs. They are efficient for locomotion, they aid in securing food, they assist in excretion, they act protectively by driving hurtful matters away.

It remains to briefly describe cilia and their mode of action. A cilium is simply a thread-like continuation of the protoplasmic cell to which it is attached. Its base, under the highest microscopic powers, differs optically from the tip; but practically the cilium is merely a

thread of undifferentiated protoplasm. From the surface of a cell there may project one to fifty cilia. This surface may appear like a hyaline layer, but it is a false appearance, and is due to the swollen bases of the cilia. Each cilium, indeed, is enlarged at its base, but narrows immediately above. This narrow neck is succeeded by a swollen portion which gradually becomes attenuated towards the tip. They vary in length, those 1-3000th of an inch long being of medium size, some are shorter, others longer. Vigorous lashing movements are characteristic of cilia. The movements are too rapid to be distinctly seen, the vibrations being usually 700 to 800 per minute.

If a fragment of the ciliated lining, say the mucous membrane from the roof of a frog's mouth, be microscopically examined in normal salt solution, the surface shows an unceasing shimmering appearance, comparable to a rapidly waving field of barley. Each cilium, it has been found, is erect and straight. Then it bends rapidly on itself, and, very much more slowly, resumes the straight condition. The force of the vibrations is in one direction, and as successive rows of cilia do not bend simultaneously, but in regular succession, the result is a progressive rythmic undulation. When the cilia are arranged in a circle or crown, as in a Rotifer, say *Melicerta*, the appearance produced is that of a swiftly rotating wheel. Hence the Rotifers have been erroneously called wheel-animalcules.

The vibrations of the cilia continue for some time after death : but, in an injured, feeble, or dying condition, they are abnormally slow, and can then be best observed. Heat (up to 104° F.) increases their vigour, carbonic acid gas arrests them, while under the influence of oxygen, and of induced electrical currents, the vibrations may be repeatedly revived. They are independent of nervous control. They are automatic and as inexplicable as the inherent contractibility of muscle. Ranvier's experiments, indeed, show that the living protoplasm, of which cilia are composed, is essentially the same as that of ordinary protoplasmic cells.

ACETYLENE, THE NEW ILLUMINANT.

By HENRY S. MARSH, A.I.C.,

Assistant Chemist, Central Experimental Farm.

The value of Acetylene as an illuminating gas is perhaps one of the most important questions amongst the many at present being discussed by those concerned in the lighting of our houses and thoroughfares.

The preparation of Acetylene gas by the action of water on the "carbides" has been known for some fifty years, but probably owing to our ignorance of the valuable properties of this gas, or the difficulty in obtaining it pure and in quantity, Acetylene as an illuminant was practically unnoticed until 1892. In that year, Maquenne prepared it by heating together, at a high temperature, barium carbonate, magnesium and charcoal; the resulting product when treated with water yielding the gas Acetylene. In 1893, Travers obtained Acetylene from calcium carbide, prepared by strongly heating together calcium chloride, charcoal and sodium, in a similar manner to that already referred to. The product, calcium carbide, evolves Acetylene when treated with water. (Proc. Chem. Soc., 1893.)

These results, however, while valuable and interesting as scientific records, were of little commercial importance, owing to the expense necessary in obtaining the materials of manufacture.

The possibility of producing Acetylene on a large scale and at a reasonable cost, by the process discovered by Wilson, has within the past year been demonstrated by scientists and experts in both England and America. Mr. T. L. Wilson made his discovery by chance, as is very often the case. While aiming at the attainment of an entirely different object, Mr. Wilson experimenting in his laboratory at Spray, North Carolina, U.S.A. (Jour. Soc. Chem. Industry, Jan. 1895), obtained after one of his fusions, a black, brittle mass, which on being brought into contact with water, rapidly effervesced with evolution of Acetylene. On further investigation, he came to the conclusion that the brittle, black mass was calcium carbide. It had been produced by fusing together finely powdered lime and coke in an electric furnace

with a current of 4,000 to 5,000 ampères. The equation which represents the action of water on this product, is as follows :—

$$CaC_2 \quad + \quad H_2O \quad = \quad C_2H_2 \quad + \quad CaO.$$

Calcium carbide + water = acetylene + calcium oxide.

Calcium carbide (CaC_2) is a dark gray, very brittle, porous-looking substance with a Sp. gr. of 2·22 at 18 degrees Centigrade. It contains 62·5 per cent. of calcium and 37·5 per cent. of carbon. On being brought into contact with water, as above stated, a double decomposition takes place, the calcium of the "carbide" combining with the oxygen of the water to form calcium oxide, or, to speak more correctly, owing to excess of water present, slaked lime ; the carbon at the same time uniting with the hydrogen of the water to form Acetylene (C_2H_2), which is readily recognized by its penetrating odour, closely resembling garlic.

Acetylene is a colourless gas having a Specific gravity of 0·91 at normal temperature and pressure ; 1·1 volumes of the gas are soluble in one volume of water. The gas when inhaled possesses the same poisonous properties as carbon monoxide, but to a greater extent. Prof. Vivian B. Lewes, of London, England, in a paper read before the Society of Arts, says that, "owing to the intense richness of Acetylene, it can only be consumed in small, flat flame burners, but under these conditions emits a light greater than that given by any other known gas ; its illuminating value, calculated to a consumption of 5 cubic feet an hour, being no less than 240 candles."

It may be liquified (according to Andsell) at a pressure of 21·5 atmospheres at zero centigrade. This property suggested to some the probable use of liquid Acetylene for portable lamps, lighting of railway carriages, etc., since thus a large volume of the gas can be stored in a very small space. It has, however, been pointed out that a sudden shock to the liquid or compressed gas frequently causes decomposition with violence. Hence, this use of Acetylene would probably be attended with danger. The carbide of calcium might be used for the purposes just referred to without any such risk, and consequently has been proposed as a convenient and cheap form to be used where liquid Acetylene would be desirable on the grounds of portability. Specially designed

lamps might be easily constructed for the production of Acetylene directly from the carbide. The latter, for railway work, could be stored in steel cylinders (the same in which oil gas in the Pintsch system at present is compressed), and by a self-adjusting stopcock the water could be brought in contact with the carbide, thus evolving the gas steadily, and illuminating the cars with a white, cool flame. The same principle, with minor alterations in detail, has been suggested with regard to "acetylene lamps" for use where other gas could not be obtained, such as country houses, etc. Such lamps would contain the carbide in the stand or pedestal, and the water simply be allowed to drop on to it. The gas so liberated could be burned from a small steatite "hole" burner. Another novel suggestion is its use for bicycle lamps and for camp lights. However, the chief use of the gas would be in enriching water gas or low grade coal gas, for which, providing its poisonous qualities did not disqualify it, Acetylene would prove of the greatest value.

We have not as yet any precise data as to the cost of calcium carbide, although some authorities have stated its price at about $15 to $20 per ton, and experiments carried out on a practical working scale have shown that one ton of the carbide yields on the mere addition of water between 10,000 and 11,000 cubic feet of Acetylene. At the same time, about 1,500 pounds of lime are produced, a material of some value in gas works.

A consideration of the marvellous illuminating power of this gas together with its simple and cheap production, leaves very little doubt but that its manufacture bids fair to become a very formidable rival of the foremost gas-enrichment processes now in practice.

OTTAWA PHYLLOPODS.

By ANDREW HALKETT.

Two years ago, when examining a shallow pool near New Edinburgh, I saw some transparent little creatures actively swimming about. Were they the larvæ of some insect? I caught a number of specimens and on placing them in a glass jar and observing their structure and movements, set about determining what they were, as they were quite new

to me. Probably few Ottawa naturalists have had the opportunity of studying these wonderful little creatures, and I venture, therefore, to present a few notes on their structure and peculiarities.

They are crustaceans, of the order Phyllopoda, sub-order Branchiopoda. The body, which is of a glassy transparency, is about half an inch long, the head being very distinct, though there is no line of demarcation between the thorax and abdomen. The eyes, antennæ, limbs, heart and forked tail, when examined through the microscope, are very beautiful. They are typical Entomostraca, for the body is divided up into segments. The anterior antennæ are short and delicate and difficult to distinguish. In the male the head is large, broad, and the posterior antennæ are converted into claspers, having the base very thick and massive, while the tip is knobbed or rather hooked. The eyes are very remarkable and quite unlike any other crustacean, so low in zoological position. Carl Gegenbaur, in his "Elements of Comparative Anatomy," draws special attention to the unusually interesting character of the eyes. The Entomostraca, as a rule, possess very simple eye spots, but in the Phyllopods, as Gegenbaur states, "we meet with a facetting of the inner surface of the cuticle covering the eye, the facets corresponding to the crystalline cones." The German anatomist further points out "by their power of movement, and their position immediately below the chitinous carapace the eyes of the Branchiopoda form an intermediate step towards those in which the chitinous carapace takes a more direct share in forming the optic organ." Further, the position of the eye, on a stalk-like process (in *Artemia* and *Branchipus*) presents a point of affinity to the higher crustaceans, such as lobsters, crabs, etc., which possess projecting stalked eyes.

The last segments of the body form a long slender tail, the terminal fork being exquisite in appearance, for under the microscope it is like burnished gold, and studded with innumerable glassy hairs. In front of the tail, the body is furnished with a large number of limbs, so modified as to perform the double function of locomotion and respiration. They are virtually gill feet. The heart is a long tube, made up of a series of chambers, and, as is usual in Arthropods, it is dorsal. The circulation of the blood, driven by this pulsating heart tube in the

back, can be watched through the microscope. A number of specimens were seen to be provided with a pouch immediately behind the limbs. These were females. This pouch is continually swayed about from side to side, and contains opaque, globular eggs. From these eggs minute creatures, like small mites, emerge in the nauplius or larval condition. As the shallow pools inhabited by these creatures are liable to dry up, the eggs which drop to the bottom possess amazing vitality. They can endure heat and dryness for long periods; but the young hatch out immediately the ponds are filled by a rainfall. I have reason to know this, for the pond from which I obtained the Phyllopods in 1893 was, soon after, dried up. I waited patiently for a year and again visited the spot, but could obtain none. The pond was dried up, and if any Phyllopods had hatched out they had wholly disappeared. On Good Friday, this year, I went to the place and found the water cold and icy, so that there were few forms of life visible, and no sign of the beautiful creatures I was looking for. Eight days later, however, I went again. It was evening and the water was warm. They had now appeared in abundance, and were swimming about in shoals, like tiny minnows. They dart away when startled just as a fish does, but soon tire and are readily captured. Several visits to the pond enabled me to take a great number, sufficient for purposes of study; but the pond soon dried up, and no more were to be had. They glide about in a vessel of water and are never for a moment still. If noticed closely, they are seen to swim back downward with the numerous feet turned towards the surface of the water. No creatures could be imagined more active, delicate and graceful in their movements. Their structure and peculiar habits of life and development are of the highest interest, and they appear to be extremely local in their occurrence.

A closely related species is *Artemia* the Brine Shrimp which lives in saline waters such as Great Salt Lake. Packard tells us that a Russian naturalist found by experiment that it was possible to convert the Brine Shrimp *Artemia* into the fresh water *Branchipus* by reducing the salty character of the water. This experiment has been much questioned, and it must be granted that such an alleged conversion of one species into another is astonishing. At any rate Phyllopods in their habits and breeding are unquestionably most remarkable creatures.

In conclusion I wish to express my indebtedness to Professor Prince, Dominion Commissioner of Fisheries, for suggestions in making these notes upon this interesting crustacean.

NOTES, REVIEWS, AND COMMENTS.

RECENT GEOLOGICAL PUBLICATIONS.

1. TAYLOR, FRANK B.—*Niagara and the Great Lakes*, Amer. J. Sc. and Arts, Vol. XLIX., 3rd Ser., No. 292, New Haven, April 1895, pp. 249 270.
2. BEECHER, CHAS E.—*Structure and Appendages of Triundeus*, ibid. pp. 307-311, Pl. III.
3. CHALMERS, ROBERT.—*On the Glacial Lake St. Lawrence of Professor Warren Uphams*, ibid., pp. 273-275.
4. WRIGHT, G. FREDERICK —*Observations upon the Glacial Phenomena of Newfoundland, Labrador and Southern Greenland*, ibid., pp. 86-94.
5. WILLIAMS, H. S.—*On the Recurrence of Devonian Fossils in Strata of Carboniferous Age*, ibid., pp. 94-101.
6. COLEMAN, A. P., PH. D., etc.—*Antholite from Elzevir*, Ontario, Amer. J. Sc. and Arts, Vol. XLVIII., 3rd Ser., No. 286, New Haven, Oct. 1894, pp. 281-283.
7. DANA, JAMES D.—*Manual of Geology*, 4th edition, New York, 1895, 1,088 pages; contains 1,574 illustrations besides two geological maps.
8. HOFFMANN, G. C.—*Chemical Contributions*, etc. Geological Survey of Canada. Part Annual Report V., Ottawa, 1895. Contains a large amount of valuable information on the geological resources of all the Provinces of Canada and especially of British Columbia.

Entomology.—UNUSUAL ABUNDANCE OF MELOID LARVÆ.—On Saturday afternoon, June 8th, near the steps leading down to the Canoe Club House at Rockliffe Park, my attention was caught by a number of small bees which were busy upon the blue flowers of a Cynoglossum. These bees belonged to a common species, *Halictus discus*, which is black, with white bands upon the abdomen, and somewhat fulvous pubescence on the legs and thorax. The individuals which had attracted my attention, however, had apparently a bright rufescent or orange thorax, and I recognized immediately that they were carrying, albeit unwillingly, numerous little larvæ, which are known as triungulins, the first stage in the life of blister-beetles. Continuing my stroll along the river road eastward, I found that around every plant in bloom, and especially around the abundant clumps of raspberry, the swarming bees carried their load of the little active larvæ. The bee

already mentioned was the most abundant and also the most generally infested; there did not seem to be an individual exempted. Several other species, however, had more or less adherents, those most conspicuous being *Prosopis affinis* and *Ceratina dupla*. Several infested individuals of a small wasp—*Odynerus albophaleratus*—were also observed. On the other hand, some species of bees seemed to be exempt. Honey-bees—*Apis mellifica*—were very numerous about the raspberries, but I could not find that one of these carried a larva, and this was also the case with the large *Andrena nivalis*, which was abundant. A careful examination of the flowering plants disclosed only a few of the larvæ crawling about the blossoms, but the number carried by the bees was quite extraordinary. The larva lurks upon the blossom until a bee visits it, and then crawling actively upon the unfortunate pilferer of sweets, clings firmly to its thorax. It is a slender little thing, orange-red in colour, except the black eyes, and somewhat pediculus-like in shape. The legs are long and provided with long claws, and these enable the larva to obtain a firm hold upon the hairs with which the bees are more or less clothed, and it is then transported to the cells constructed by the host for its own future brood, and therein finding suitable provision, lives as a parasite, and undergoes interesting changes before it appears as a beetle, the name of which I cannot give, for, although I have often taken them, my knowledge of these larvæ is too scanty for a determination of the species. The larvæ, as stated, attach themselves about the thorax of the bee, and so numerous were they upon this occasion that they seriously embarrassed the flight of their unwilling hosts. Numerous bees could be seen dropping upon the foliage and endeavoring to comb off with their legs the undesired swarm, but in vain, so tightly did the intruders cling. Above and below they clustered, at the base of the wings and among the legs, clinging to the hairs of the bee or to one another. My estimate of the number carried by each individual of *Halictus discus* was between 40 and 50, and to verify this I collected four individuals not more conspicuously burdened than their neighbors. One of these I have pinned in my collection with the swarm upon it, and the remaining three were found to carry 165 larvæ, or an average of 55 for each bee. When we take into account the hundreds, indeed I may say thousands, of these bees which were similarly infested, we will get some idea of the immense number of the larvæ which had developed in the limited area examined.

W. H. H.

EREBIA DISCOIDALIS, Kirby.—Some years ago a few specimens of this very rare arctic butterfly were taken at Sudbury, Ont., by Mr. J. D. Evans, on 12th May. Ever since that time the leaders of the Entomological branch have made great efforts to obtain eggs of this species so as to breed the larvæ through their different stages, to record the life history, and to describe the appearance of the young caterpillars. Although known to occur in comparative abundance at Calgary, N. W. T., no one could succeed in getting the eggs until this season, when Mr. T. N. Willing, the Provincial Secretary of the Botanical Society of Canada for the Northwest Territories, and one of our members, succeeded in obtaining eggs which he sent to Ottawa. The eggs were laid on May 10th and hatched on the 29th. The small caterpillars fed readily on lawn grass, *Poa pratensis*, and several kinds of fine leaved sedges, *Carices*, and are now growing rapidly: the first moult was passed on June 7th and the second on the 18th. The young larvæ were 2½ millemeters in length when first hatched, 5 mm. after first moult and 9 mm. after 2nd moult. The general appearance of these little caterpillars may be thus described: Slender caterpillars, whitish in colour, with a dark brown stripe down the middle of the back and three lateral stripes along each side. The uppermost of these is broken up into separate elongated blotches, and the lowest has on its lower margin the small black spiracles. Below these is a wide, yellowish white, conspicuous stripe: the lower surface is mottled thickly with reddish brown, and bears a narrow white stripe along the sides, lying just above the bases of the legs. After the first moult the colour is darker and the skin has many more bristles than in the first stage: after the second moult the body is so much darker that the general colour would be described as brown.

J. F.

Ornithology.—A NEW BIRD FOR EASTERN ONTARIO.—Mr. F. A. Saunders reports the appearance of a Dickcissel, *Spiza americana*, at the Central Experimental Farm.

Previous to this, the only record of this species for Canada was made at the most southerly point of the Dominion,—Point Pelee, Lake Erie. The presence of so distinguished a Southerner in Ottawa being

worthy of a mark of special attention from the local students of bird life, visits to the farm were made, on Mr. Saunders invitation, by Mr. W. A. D Lees and the writer, both of whom obtained very satisfactory interviews at close quarters. The bird is a male in fine plumage; the sulphur-yellow breast, black throat patch and white chin are well marked, as well as the ashy tracts on the sides of the head. Mr. Saunders has seen it daily since 15th June, always haunting the same locality on the farm, an area of not more than three acres, and singing almost all day long. He has not been able, so far, to find either mate or nest, though once or twice a bird has been seen which he hoped might prove to be the female dickcissel, but which would not permit him to come near enough for identification.

In the hope that they may be nesting it has been thought best not to "collect" the male bird. They will be protected on the Experimental Farm, and possibly may return another year.

Since the above observation was made Mr. W. E. Saunders of London, Ont., who was the first to discover the dickcissel at Point Pelee in 1884, writes that he has seen several of the species this season in the County of Middlesex. A. G. K.

The Air at Ottawa.—Mr. F. T. Shutt, F.I.C., President of the O.F.N.Club and Mr. Anthony McGill have sent the OTTAWA NATURALIST a copy of their recent paper entitled: "*Some Observations on the quality of air at Ottawa.*"* In this paper the authors give some of the results obtained by them in the work they undertook at the instance of the Department of Public Works to examine the air of the House of Commons Chamber at Ottawa. The methods employed are described, and the results appear in the form of estimations of the carbonic acid present in the air on Parliament Hill. The authors say:—"It will be seen that the quantity (of carbonic acid) varied from 3·0682 volumes per 10,000 on the 11th June to 3·7177 per 10,000 on 13th June." The experiments were made in 1892 and the presence of CO_2 was estimated by Pettenkofer's Process. The mean amount of carbonic acid gas (omitting the first estimation made) is 3·5918 volumes per 10,000. Compared with results obtained in other cities the quality of the air on Parliament Hill is excellent.—H.M.A.

*Trans. Royal Society of Canada, Vol. XII, Sec. III, 1894.

EXCURSIONS.

Excursion No. 2, Galetta.—Weather of the bright, exhilarating order; a large gathering of enthusiastic naturalists, and a region rich in scenery and varied in the natural products, all combined to make the excursion to Galetta on the 15th of June one of the most enjoyable in the history of the Club's outings.

About 140 excursionists gathered at Elgin street station at 1.45 in the afternoon, from whence they were taken by the Parry Sound railway to Galetta, some 35 miles distant. The train slowed up at McDougall's and Graham's Crossings, where the numbers were swelled by the addition of parties from the Experimental Farm and Richmond Road.

The railway passes through some of the finest agricultural districts of Carleton County, now "in verdure clad" with the green of the meadows and grain fields.

The village of Galetta is reached in an hour. Here the party is met and cordially welcomed by Mr. G. C. Whyte, a brother of the well-known enthusiast in botany, Mr. R. B. Whyte, at whose recommendation the locality at Galetta was chosen. The town hall was kindly placed at our disposal, and was used as a storing room for wraps and lunch baskets.

The next move was to collect forces, designate leaders for the various branches, and begin the serious business of the afternoon. It was at this time that the unavoidable absence of such well appreciated and willing leaders as Mr. Fletcher, Drs. Ami and Ells, was felt and deeply regretted.

President Shutt then explained the geography of the district and asked Messrs. Whyte and Craig to lead in the search for botanical specimens; while Prof. Prince, Messrs. Halkett, Whiteaves and Ferrier represented the zoological and geological sections.

The principal exploring grounds lay along the banks of the Mississippi, a tributary of the Ottawa, and in the vicinity of Chats Lake.

It may be interesting to note here that Galetta is situated on a spur of the same Laurentian formation which crosses the Ottawa River at the Chats Falls. This ridge of gneiss crops out prominently at

Galetta and adds much to the variety and beauty of the scenery by causing a series of interesting falls at the point of intersection by the Mississippi. The power furnished by these falls is utilized to operate grist and woolen mills in the village; the long lines of comfortable looking frieze displayed upon the stretchers testified to activity in business.

It may hardly be taken for granted that all the excursionists were true field naturalists, and therefore came solely to pry into nature's secrets. From the happy appearance of many interesting groups of from two to a dozen persons who were not communing with nature it is safe to say that secrets of another order were made, interchanged and investigated during the afternoon. However that may be, it was a well satisfied party which gathered at six o'clock at the call of the President in Whyte's beautiful grove 'neath "the murmuring pines and the hemlocks" — in fact to hear an account of the different "finds" by the leaders of the different sections.

It was much to be regretted that Geology and Entomology were not represented owing to absence or modesty on the part of the leaders.

Prof. Prince, Dominion Commissioner of Fisheries, spoke interestingly regarding some specimens which he had succeeded in capturing. In the Botanical section an interesting collection was exhibited by Messrs. Whyte and Craig.

Among the specimens collected were good representations of the Wild Orange Red Lily, *L. Philadelphicum*, which Mr Whyte recommended for garden cultivation, and the Carolina or thornless rose, *R. Carolina*. Flowering branches of *Potentilla fruticosa*, shrubby five finger, were also shown and described by Mr. Whyte as a most desirable shrub and one whose beauty was enhanced by cultivation.

This region seemed to be particularly rich in climbing plants, as Mr. Craig extolled the merits of four useful and ornamental species, mentioning Virginia creeper, *Ampelopsis quinquefolia*; Climbing Bitter Sweet, *Celastrus scandens*; Moonseed, *Menispermum Canadense*; and Climbing Bindweed, *Polygonum cilinode*. Several honeysuckles were shown in fruit and in flower, the most beautiful at that time being

the Hairy honeysuckle *L. hirsuta*, Eaton. This was covered with its charming orange yellow colored flowers, making it most attractive. Others exhibited were the native Wolf Willow, *Eleagnus*, of the Northwest in fruit, and Saskatoon, *Amelanchier*, in addition to representations of our best conifers.

President Shutt added some interesting remarks on the role of the Leguminosae in agriculture, and congratulated the club on its successful outing. Mr. Sinclair, B.A., of the Normal School also spoke felicitously of the benefit of such excursions. A number of members of the Ottawa Camera Club who were of the party succeeded in getting several interesting views of the Mississippi Falls.

The 8.30 train brought to Ottawa a cheerful and thoroughly satisfied party of excursionists, each with a strong desire to say "Rah !" for Galetta.

J. C.

July and August Excursions.—Owing to the absence from town of a number of the officers and members of the O. F. N. Club, it has been decided not to hold any field day during July.

It is probable that the August NATURALIST will contain an announcement of one, to take place about the middle of that month.

THE LATE PROFESSOR HUXLEY.

British Science has lost one of its foremost leaders by the death of Professor Huxley. He was recognized the world over as the greatest of modern biologists and he was not only a profound original discoverer he was also one of the best popular expounders of science. His contributions to science were of a voluminous and varied character, and in the field of Comparative Anatomy his work was especially brilliant and successful. As a lecturer he had but one rival, viz.: the late Professor Tyndall, and the interesting circumstance may be recalled at this time, that both these scientists were, in the course of their career, candidates for Professorships in one of our Canadian Universities (Toronto). British Science may look with just pride upon the achievements of the late Professor Huxley.—E. E. P.

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*ARGON: A NEWLY DISCOVERED CONSTITUENT OF THE ATMOSPHERE.

By FRANK T. SHUTT, M.A., F.I.C., F.C.S.

Our first knowledge regarding the chemical constitution of the atmosphere may be said to date from Priestley's time. In 1774 this English chemist discovered Oxygen by the experiment, now historical, of heating the red oxide of mercury by means of the sun's rays, collected and focussed by a burning glass. He worked out somewhat its chemical properties and made known its essential characteristic as the great supporter of animal life and of combustion. He termed it "*Dephlogisticated air*," because, as he said, "it is so pure, so free from phlogiston,"—the hypothetical principal of inflammability of an obsolete theory.

Two years previously, Rutherford, Professor of Botany in Edinburgh, had experimented with the residual gas produced by respiration of animals in closed vessels containing air. He found it to contain a gas (carbonic acid) that could be absorbed by caustic potash and further a colourless gas, which could not thus be absorbed, that extinguished the flame of a candle and did not support animal life. This was the discovery of phlogisticated air or Nitrogen.

Scheele, a Sweedish chemist, was, perhaps, the first to recognize clearly that the atmosphere consisted of these two gases. He confirmed the results of Priestley and Rutherford, bringing them together and establishing from them the dual character of the atmosphere.

So far, however, all the work was of a qualitative character. Cavendish, another English chemist (1731-1810), was the one who established by careful, thorough and skilful quantitative work the com

*Read before the Toronto University Club of Ottawa, May 10th, 1895.

position by weight and by volume of the atmosphere. This was in 1781. It is supposed that Cavendish made no less than 400 analyses of the air. The mean result of his labours was that 100 volumes of air contain 20.83 parts by volume of oxygen.

Since that time Gay-Lussac and Humbolt, Davy, Thomson, Kuppfer and, later by more accurate methods, Regnault, Bunsen, Lewy, Stas, Dumas, Boussingault and others, have carefully analysed the air. Their results serve practically to corroborate those of Cavendish.

It is now well known that the amount of oxygen in normal air varies at different times and in different localities, but the work of all the most careful investigators goes to show that the limit of variation lies within 20.9 and 21.0 volumes of oxygen per 100 of air. Considering this, we may well marvel at the high degree of accuracy of this quantitative work of Cavendish—more especially when we think of the apparatus and methods of his day.

For more than a hundred years then, it has been thought that the atmosphere consisted chiefly of a mixture of the elementary gases, oxygen and nitrogen. We have also for many years recognized as present in the aerial ocean that envelopes our globe, small and variable quantities of carbonic acid [3 to 4 volumes per 10,000] and vapour of water. Under artificial circumstances, traces of sulphuretted hydrogen, ammonia, nitric and other acids, organic matter, etc., are noticed.

We now have to chronicle a further step in our knowledge of the atmosphere's composition.

Lord Rayleigh, the eminent English physicist, and William Ramsay, professor of chemistry at University College, London, at the meeting of the British Association held in Oxford in August last, surprised the world—scientific and lay—by the announcement that they had discovered another atmospheric constituent.

To give you some idea how these scientists came to make the discovery of this constituent—which the weight of the proof indicates to be an element hitherto unknown—I shall make free use of an abstract of a paper read by them before the Royal Society on the 31st of January of the present year. Priestley had discovered oxygen by chance: the present discovery was the result of an elaborate

and careful series of experiments—extending over a period of several years—conducted and repeated on thoroughly scientific lines, by means of physical and chemical methods, the outcome of the combined labours and knowledge of physicists and chemists of the age, which I think we may safely say is the most brilliant, and withal the most accurate that science has ever known.

Lord Rayleigh had previously proved that nitrogen extracted from chemical compounds was about one-half per cent. lighter than "atmospheric nitrogen." Thus, the [mean] result for the weights of nitrogen gas in the globe, prepared from the following compounds:—Nitric oxide, nitrous oxide, ammonia nitrite, urea was 2.2990, while that for "atmospheric nitrogen" prepared and purified by the best hitherto known methods was 2.3102. Reduced to standard conditions, their figures give 1.2505 grms of "chemical" nitrogen and 1.2572 grms of "atmospheric" nitrogen per litre. This difference, though small, was quite sufficient to arouse in the mind of Lord Rayleigh the suspicion that "atmospheric nitrogen" was not pure nitrogen.

We may very briefly at this stage consider the details of one method for the preparation of nitrogen, used in these investigations of Lord Rayleigh and Prof. Ramsay: By the ignition of the metal magnesium in nitrogen, a compound of the two is formed, (magnesium nitride) which on subsequent treatment with water yields ammonia; from the latter by many methods the combined nitrogen may be determined.

As magnesium nitride, nitrogen was extracted from the air, then liberated with water and carefully estimated. The result obtained proved that, prepared in this way, nitrogen—which in the first stages of the method of preparation was part of the atmosphere—was practically identical in physical constants with nitrogen from chemical compounds.

It was, therefore, conjectured that nitrogen separated from the atmosphere by all the methods save the one just quoted, was not pure nitrogen. What then was its impurity? In other words, is there not another gaseous constituent in the atmosphere unknown?

We have now stated briefly the grounds for suspecting a hitherto undiscovered constituent in the air. In a review of this character it is

impossible to give an account of all the experiments these scientists made in order to make sure that the discrepancy in weight already referred to was not due to impurities. Suffice it to say that all possibility of the nitrogen prepared from chemical compounds being a mixture, was shown by varied and careful experiments to be without any foundation.

METHODS OF PREPARATION.

Of the elements that combine directly with nitrogen, magnesium was chosen as the best. When nitrogen is passed over this metal in a hard glass tube heated to redness, absorption takes place with incandescence. The authors state that from 7 to 8 litres of nitrogen can be absorbed in a single tube. The nitride so formed is a porous, dirty orange coloured substance. Red hot magnesium therefore was used to absorb or get rid of the nitrogen, while red hot copper was similarly used to combine with the oxygen of the air experimented upon.

The method of Cavendish, by "sparking" nitrogen with oxygen in the presence of an alkaline liquid, was employed by the authors in their earlier experiments. This finally resulted in obtaining a small quantity of residual gas, proportional to the volume of air operated upon, which could not be further oxidised. Its spectrum proved that it was not nitrogen. It was, in fact, the newly discovered element, argon.

The abstract then gives the details of an experiment in which the oxygen of the air under trial was absorbed by red copper. This left a gas of the density of 14.88. This, as the investigators say, while not conclusive, was encouraging. Then by passing backwards and forwards such "atmospheric nitrogen" over red hot magnesium they obtained after 10 days about 1500 c.c. of this heavier gas. This was treated with a large number of chemical absorbents to purify it, and as a result they had 200 c.c. of a gas of the density of 16.1. Still further absorption yielded a gas with a density of 19.09. This on "sparking" with oxygen eliminated the last traces of nitrogen, the remaining gas having 20.0 as its density. This showed, by spectrum analysis, lines not reconcilable with any known element.

The method of atmolysis was then tried. Atmospheric nitrogen, after separation of oxygen by red hot copper, was diffused through a number of tobacco pipe stems. The nitrogen so obtained was denser

than that of atmospheric nitrogen not so treated. This served to corroborate their previous results and conjectures.

The preparation of argon on a large scale is a tedious process. It involves first the separation of the oxygen by red hot copper and the drying by chemicals of the remaining gas. It is then passed several times over magnesium turnings heated to bright redness. For this purpose mercury gas holders and a Sprengel vacuum pump are used. It takes at least two days to effect perfect elimination of the last traces of nitrogen.

The density of this gas—argon—as calculated from a mixture with oxygen, is 19.7, and on the assumption of its proportional amount in atmospheric nitrogen 20.6. As prepared from Nitride of magnesium, the average density from a number of determinations in 19.90. This gas gave no spectrum of nitrogen in the vacuum tube.

It would avail little for me to give here a minute account of the characteristic lines of the spectrum of argon. Mr. Crookes, whose assistance as an authority on spectrum analysis was asked, has made a careful record of the wave-lengths. Part of the evidence from this work would seem to indicate that argon is a mixture and not an element, since two distinct spectra at different temperatures were noticed. We however, know that the spectrum of certain elements is apt to vary with the temperature and pressure under which the experiment is made. Mr. Crookes concludes "that Lord Rayleigh and Prof. Ramsay have added one, if not two, to the family of elementary bodies."

Argon is about two and a half times as soluble in water as nitrogen. It has been proved that dissolved gases from rain water furnish "nitrogen" considerably heavier than true pure nitrogen. This greater solubility of argon has already suggested a method for its preparation.

To Professor Olszewski, of Cracow, was first assigned the task of determining argon's physical constants. His results are that it has a lower critical point and a lower boiling point than oxygen. He has liquefied it and, further, solidified it to white crystals. At ordinary temperature it is a colourless, odourless gas.

The ratio of its specific heat, the result of a number of experiments, calculated from the velocity of sound in it, is 1.66. That for diatomic gases varies from 1.29 to 1.42. From the fact now recorded it appears to be

a gas in which all the energy is translational; in other words, its molecule consists of one atom, and in this respect resembles mercury gas at a high temperature.

All attempts—and they have been many—to combine argon with other elements have failed. Conditions have been altered, but with the same result. It, therefore, well deserves the name given it, which is derived from the Greek and means inert. So far, its inertness is without a parallel in chemical science. I ought to mention that within the last month, M. Berthelot has announced that he has by means of the silent electric discharge got argon to combine with several organic bodies. Details of these results are promised at an early date.

Avogadro's hypothesis demands that the density of a gas should be half its molecular weight. The density of argon is 20 [approximately], its molecular weight must therefore be 40. The physical data go to show that it is monatomic, *i.e.* the atom and the molecule are identical, hence its atomic weight, if it be an element, is 40. The definite physical constants obtained by Olszewski certainly go to prove its elementary nature.

Finally, is there a place for a new element of such atomic weight in Mendeleef's periodic system? It does not appear so. The question, therefore, arises, whether the periodic classification of the elements that of late years has received no such attention from chemists, is altogether a complete and accurate one. May there not be elements that do not find a place there? Further work will no doubt throw light on this important matter.

Argon has been sought for in mineral and vegetable matter, but so far in vain. The atmosphere, of which it constitutes about one one hundred and twenty fifth part by volume, appears to be its only habitat.

It is altogether too early to ask regarding the commercial or utilitarian value of this discovery. I have no doubt that ere long we shall know of the part—perhaps a very important part—that it plays in the economy of nature and probably in the arts and manufactures of the day. This discovery undoubtedly marks the highest achievement in the chemistry of the times, but it must not be forgotten that a very large part of the work was plotted and successfully carried out by one who occupies a first place among the advanced physicists of the day.

A MORNING AMONG MOOSE.

By PROF. EDWARD E. PRINCE,

Dominion Commissioner of Fisheries, Ottawa.

Some months ago, when on an official tour in New Brunswick, a very unusual opportunity offered itself of seeing a small herd of Moose under conditions resembling in many respects those characteristic of the wild state.

Everybody is familiar with the magnificent head of our largest native mammal, and the imposing palmate horns are a common ornament about our houses and hotels ; but there are comparatively few people who have ever beheld a living moose, and fewer still who have seen this noble animal in his native haunts. It was with no ordinary pleasure that, quite unexpectedly, I found myself one morning with a few hours at liberty, and was thus enabled in company with a friend, to take a drive of four or five miles with the view of seeing the moose. We reached the small tract of forest country where, we had been informed, the moose were located, and having found the owner, he most willingly volunteered to show us his splendid captives. The personage in question was a quaint character—a veritable Robinson Crusoe in appearance and habits of life.

From his log hut he led us along a tangled forest path, through an extensive wooded area covering some hundreds of acres securely fenced in. We soon saw signs of moose. All the young shoots of certain trees had been nibbled off, or rather had been sharply nipped off, as if by a sharp, clean bite. In some places hardly a young leaf or terminal bud could be seen. The moose, as is well known, prefers above all things the young green tender sprigs on the branches of certain trees. We also noticed on the path at several points dung traces, quite unlike those of the cow, horse or sheep, being in fact olive brown ovoid bodies, not unlike nut megs in shape and size. The trees now became thicker and the foliage more dense, and our guide warned us to walk more slowly and carefully, and to avoid treading on dead dry branches. Though partly domesticated the moose, we were informed, never wholly

loses the fear produced by unexpected sounds, and moves off in alarm on hearing the cracking of dry branches in the distance, or other warning noises. We were further warned that if we suddenly came upon one of the huge "pets" of which we were in quest, it was advisable to dodge immediately behind a tree. "Always keep a tree between you and the moose," said our guide, for the instinctive habit of suddenly striking out with his ponderous fore-foot is never got rid of. So powerful is the stroke of the sharp cloven hoof that, like the slash of a sabre, its effect is almost always fatal, as many a hunter has found to his cost. As we advanced slowly and noiselessly our guide called in a soothing tone, "Coom," "Coom," "Coom," just as a dairy maid calls her favourite calf, and ere long signalled to us to stop. Then our guide putting up his hand pointed to a small clear space in the midst of large trees. Lo! under the leafy roof we could just distinguish two large brown masses on the ground. There were a couple of moose demurely chewing the cud in this shady retreat! The colour of the hide, a dark chocolate, so perfectly harmonized with the shadows and tree trunks around, that the outlines of the two animals could be discerned only with difficulty. Both had their heads turned away from us, and the back alone was visible, much of the body being hidden by the intervening undergrowth. The explanation of the peculiar position in which moose rest during the day is easy. The back is always turned towards the direction whence the wind blows. As the wind changes the moose change their position. On this occasion the wind was from the north, and we were moving south, so that a very slight wind blew towards them from us. The moose is endowed with a sense of smell so acute, that anything approaching from the windward side is at once detected by them without the aid of eyes or ears. The head being turned in the opposite direction, the eyes and ears are thus able to detect any approaching danger from that quarter. Such is the universal habit of the moose. He detects danger by scent in one direction, by sight and sound in the other direction. With his back turned towards the wind the moose is able to detect danger from whatever quarter it comes. This was soon demonstrated, for, as we came nearer, one of them rose quickly and turned round in our direction, eyeing us sullenly. He was a magnifi-

cent animal with widespreading antlers and a height at the shoulders of at least seven feet. His stout limbs of a pale ochre colour, like the trunks of young trees, his sides deep brown, like faded foliage in shadow, his head and back much paler and glistening as if frosted, resembling a mass of leaves with the light glancing across them. We were able to view at eight or ten yards distance this kingly quadruped, always remembering the precaution to keep within reach of a stout cedar or beech. There was no difficulty in noting the peculiar features of the living moose so utterly unlike the crude and unshapely stuffed skins which we usually see. The short deep body, the monstrous towering shoulders surmounted by a bushy erect mane, the thick abbreviated neck, the long and ponderous head, and, above all, the gracefully curved snout, with pendulous upper lip, almost as mobile as the elephant's trunk, all combined to give a peculiar weird grandeur to the animal. It is impossible in a museum specimen to produce certain graceful features in this uncouth giant. Thus the soft roundness of the ears is always lost, and the elegant curve of the slit-like nostrils it is impossible to preserve after death. The strange, somewhat "lack-lustre" eye, to adopt Shakespeare's expression, is ludicrously small for so large a creature. It is, it must be admitted, a wicked eye, very unlike the large liquid eye in most of the deer tribe, nor has it the benignant intelligence of that organ which we see in the elephant, or the inoffensive inquiring look of the whale's eye, as viewed at half a dozen yards' distance from a fishing boat; but it resembles rather the suspicious ill-natured eye of the bull or the rhinoceros. The eye in fact is dull, dark, and with hardly any indication of white. From the throat of the bull hung the elegant tail like "bell," a bushy appendage, which reaches its full development only when the creature is adult. The huge trumpet-like ears are extremely bushy, similar to the condition of the brown bear, and as mobile and rapid in movement as the ears of a horse.

The living moose combines many of the general features of the horse, the deer, and the pig. Indeed the young calf-moose is strikingly pig-like in appearance, on account of the long snout, the large pointed ears, small eyes and sloping back.

Our guide assured us that he had captured, when practically full grown, the splendid bull-moose which we had the privilege of seeing, and had brought it from the wild Quebec country, north of the Lower St. Lawrence to New Brunswick on a rudely constructed raft—a marvellous instance of a hunter's skill, perseverence and success.

Taking a stout maple branch in his right hand he walked up to his colossal pets, holding out a piece of turnip as a dainty bribe, and uttering his cry "Coom," "Coom." The cow moose rose and readily took the piece offered, but the bull was more reserved and only after much persuasion condescended to accept a fragment of the turnip, leisurely stretching out his head and seizing the piece with his elastic lips after the manner of a horse.

Our guide patted the creature familiarly, and seemed to take no such precautions as would be necessary for a stranger to take. It is true he was cautious in approaching the bull at first: but the animal was clearly semi-domesticated. When the cow rose, the absence of horns and of the bell, and the meagre character of the upright mane took away from her appearance. Her size too is rather smaller, and the ears appear, if anything, larger and more prominent: but the absence of horns may account for that. She lacks the impressive grandeur of the bull. Soon a small calf-moose, about as large as a 12 hands pony, appeared in response to repeated calls. It was about a year old and appeared quite tame, pushing its huge nose under the armpits of its master, and exhibiting signs of affection. The lips are far less pendulous and mobile in the calf. A further walk of a quarter of a mile enabled us to see another cow, whose ears were crumpled and shorn at the tip. This animal when newly captured, and tied about the neck, head and ears with ropes, had been frost-bitten, and had lost the tips of the last-named organs. Finally a fifth moose was seen, a calf born in captivity, and so tame as to jump over a fence at the command of its master. It was a surprise to see a heavy, uncouth, almost unwieldy, animal such as this, take a fence four or five feet high with greater lightness and ease than a hunter. Our guide not being pleased with his juvenile pet's performance, administered one or two blows with his cudgel, whereupon the creature cried in a sharp, ill-natured manner,

not unlike the cry of a horse in pain or anger, but less loud and strong. Indeed the sound was ludicrously weak and shrill for a quadruped of such large dimensions. This feeble, ill-natured cry resembled strongly the weak cry of the monstrous rhinocerous, the voice of which is so ill proportioned to the animal's size.

It was interesting to note that our departure was watched with the utmost keenness and suspicion by the moose. They followed us with ears and eyes, turning round when necessary to observe our movements as we hurried away. It was an impressive spectacle to see in the distance the two massive captives standing in their leafy retreat, the pale grey horns of the bull rising majestically amongst the branches.

Cases of tame moose are familiar enough in Canada: but it is a rare experience, except to the hunter, to see a herd of moose under conditions so resembling the wild state. One gained some notion of their appearance in the forest. One sad reflection only could not be avoided, arising from the probability that in spite of laudable steps to preserve these noble monarchs of our Canadian forests, the cruelty and barbarity of man is almost certain ere long to exterminate them. Not merely pot hunters, who slay the helpless mother moose just before and after bearing her young, but professed sportsmen, have no mercy. Their relentless efforts may ere long deprive our Dominion of the moose in our forests as they have already robbed us of the royal buffalo on our prairies, unless severe and righteous measures be effectively carried out.

LIST OF NATIVE TREES AND SHRUBS GROWING AT THE CENTRAL EXPERIMENTAL FARM, OTTAWA, JULY, 1895.

By W. T. MACOUN.

Interesting and numerous as are the species and varieties of trees and shrubs from foreign countries now growing at the Central Experimental Farm, which by their beauty and peculiarities of form, leaf, flower and fruit attract so much attention from visitors, it must be a satisfaction to Canadians to know that a large number of our native trees and shrubs play no small part in the pleasing effect produced by the tasteful grouping of the various species and varieties on the ornamental grounds. In the arboretum many of our native trees and shrubs may now be studied with much profit by those interested in botany and while more species are yet to be added, the local botanist will see at the Farm many that are not to be found in the Ottawa district.

It was thought that a list of the native trees and shrubs growing at the Central Experimental Farm, in cultivation or otherwise, would prove of some value to the members of the Ottawa Field Naturalists' Club, and the accompanying list is herewith submitted.

The classification is according to Prof. Macoun's "Catalogue of Canadian Plants." The distribution of each species is given; whether it is a tree or shrub; its hardiness at Ottawa; and when ornamental mention is made of the fact. A few woody climbers are also included. There will be found in the list the names of 178 species and varieties.

I. RANUNCULACEÆ Crowfoot Family.

1. CLEMATIS, Linn. (Virgin's Bower.)

(1.) C. VERTICILLARIS, DC. Whorl-leaved Clematis.
Que.; Ont.; Man.; N.W.T.; B.C.
Woody climber; hardy; flowers ornamental.

(2.) C. VIRGINIANA, Linn. Virginian Clematis.
N.S.; N.B.; Que.; Ont.; Man.
Woody climber, hardy; flowers ornamental.

(3.) C. LIGUSTICIFOLIA, Nutt.
N.W.T. ; B.C.
Woody climber ; hardy ; flowers ornamental.

II. MAGNOLIACEÆ Magnolia Family.

17 LIRIODENDRON, Linn. (Tulip Tree.)
(78). L. TULIPIFERA, Linn. Whitewood.
Western Ontario.
Large tree ; semi-hardy ; leaves and flowers ornamental.

18. MAGNOLIA, Linn. (Magnolia.)
(79.) M. ACUMINATA, Linn. Cucumber Tree.
Western Ontario.
Large tree ; semi-hardy ; leaves and flowers ornamental.

IV. MENISPERMACEÆ—Moonseed Family

20. MENISPERMUM, Linn. (Moonseed.)
(81). M. CANADENSE, Linn. Canadian Moonseed.
Que. ; Ont. ; Man.
Woody climber ; hardy.

V. BERBERIDACEÆ Barberry Family

21. BERBERIS, Linn. (Barberry.)
(84). B. AQUIFOLIUM, Pursh. Oregon Grape.
B.C.
Low shrub ; semi-hardy.

XIX. HYPERICACEÆ—St. John's Wort Family.

97. HYPERICUM, Linn. (St. John's Wort.)
(344). H. KALMIANUM, Linn. Shrubby St. John's Wort.
Ontario.
Low shrub ; hardy ; flowers ornamental.

XXI. TILIACEÆ—Linden Family.

105. TILIA, Linn. (Basswood. Linden.)
(366). T. AMERICANA, Linn. Basswood.
Que. ; Ont. ; Man.
Large tree ; hardy.

XXIV. RUTACEÆ—Rue Family.

112. XANTHOXYLUM, Colden. (Prickly Ash.)
(392.) X. AMERICANUM, Mill. Northern Prickly Ash.
Que.; Ont.
Tall shrub; hardy.

113. PTELEA, Linn. (Hop Tree.)
(393.) P. TRIFOLIATA, Linn. Shrubby Trefoil.
Western Ontario.
Tall shrub; hardy.

XXV. ILICINEÆ—Holly Family.

115. ILEX, Linn. (Holly.)
(395.) I. VERTICILLATA, Gray.
N.S.; Que.; Ont.
Shrub; hardy; fruit ornamental.

XXVI. CELASTRACEÆ Staff-tree Family.

117. CELASTRUS, Linn. (Staff-tree.)
(379). C. SCANDENS, Linn. Wax-work. Bitter-sweet.
Climbing shrub; hardy; fruit ornamental.

118. EUONYMUS, Tourn. (Spindle-Tree.)
(399.) E. ATROPURPUREUS, Jacq. Burning Bush.
Ontario.
Tall Shrub; hardy; fruit ornamental.

XXVII. RHAMNACEÆ. Buckthorn Family.

120. CEANOTHUS, Linn. (New Jersey Tea.)
(401.) C. AMERICANUS, Linn.
Ontario.
Low shrub; hardy.

121. RHAMNUS, Tourn. (Buckthorn.)
(405.) R. ALNIFOLIA, L'Her.
N.B.; Que.; Ont.; Man.; N.W.T.
Low shrub; hardy.

XXVIII. VITACEÆ—Vine Family.

122. VITIS, Tourn. (Grape.)

(408.) V. LABRUSCA, Linn. Northern Fox Grape.
Western Ontario.
Climbing shrub; hardy.

(409.) V. CORDIFOLIA, Lam. Frost Grape.
N.S.; Que.; Ont.; Man.
Climbing shrub; hardy.

123. AMPELOPSIS, Michx. (Virginian Creeper.)

(411.) A. QUINQUEFOLIA, Michx.
Que.; Ont.; Man.
Climbing shrub; hardy; leaves ornamental.

XXIX. SAPINDACEÆ—Soapberry Family.

124. STAPHYLEA, Linn. (Bladder Nut.)

(412.) S. TRIFOLIA, Linn. American Bladder Nut.
Que.; Ont.
Tall shrub; hardy.

125. ACER, Tourn. (Maple.)

(414.) A. PENNSYLVANICUM, Linn. Striped Maple.
N.S.; N.B.; Que.; Ont.
Small tree; hardy.

(415.) A. SPICATUM, Lam. Mountain Maple.
N.S.; N.B.; Que.; Ont.; Man.
Tall shrub; hardy.

(417.) A. CIRCINATUM, Pursh. 'Vine Maple.
B.C.
Tall shrub or small tree; semi-hardy.

(418.) A. GLABRUM, Torrey.
B.C.
Tall shrub; hardy.

(419.) A. SACCHARUM, Wang. Sugar Maple.
N.S.; N.B.; Que.; Ont.
Large tree; hardy; leaves ornamental in Autumn.

NOTES, REVIEWS AND COMMENTS.

*CHAPMAN'S HANDBOOK OF BIRDS OF EASTERN NORTH AMERICA.

If supply may be taken as an index of demand, the large number of books upon ornithology which have appeared within the last few years furnishes an encouraging proof of a growing desire for closer acquaintance with bird life, both on the part of the nature-lover and of the scientific student. Probably no book that has appeared for a long period is so well fitted to satisfy the needs of both these classes as the one whose title has just been quoted. Accuracy and fullness of description, covering all external characters, including every phase of of seasonal and sexual plumage in each species, have been attained without an undue use of technical language: and these specific descriptions alternate throughout the body of the work with delightful sketches of the habits of each bird. Many of the life-histories are from such well known writers as Mrs Olive Thorne Miller, Miss Florence Merriam, William Brewster, Ernest E. Thompson, Bradford Torrey, etc.

The author is by profession a closet naturalist, but his chapter on "The Study of Birds out of Doors" can only have been written by one who is a lover, as well as a student, of birds, and whose acquaintance with them must have begun at a period when professional methods and closet work were as yet matters of the future. Still the curator of the museum comes to the surface in the following recommendation: "If you would name birds without a gun, by all means first visit a museum and with text-book in hand study those species which you have previouly found [by reference to the nearest local list] are to be looked for near your home. This preliminary introduction will serve to ripen your acquaintance in the field." One field student can remember how a preliminary acquaintance with a row of mounted birds standing "at attention" on the shelf of a museum has only served to deaden the

* Handbook of Birds of Eastern North America—with Keys to the Species and Descriptions of their Plumages, Nests and Eggs, their Distribution and Migrations, &c. &c. &c. By Frank M. Chapman, Assistant Curator of the Department of Mammalogy and Ornithology in the American Museum of Natural History, New York City, &c. New York: D. Appleton & Company, 1895. 12 mo., xiv. + 421 pp.

interest that would otherwise have been felt in their living relatives. On the otherhand, an illusive song, a few unsatisfying glimpses through the leaves or over the distant tree-tops can awaken a keenness of hunting instinct that, following its object through thicket and marsh and stumbling over two or three false identifications, will end in a knowledge, born of deep friendship between man and bird, that can be come at in no other way. Such a plan may be too slow for this end of the century, but its results have a staying-power about them. *Afterwards* when inspecting the museum specimens, the student will know what points he should study most carefully; and whenever that song is heard again the leaves grow greener and the air fresher and other things come back to mind that to miss would be loss indeed.

Among the most valuable features in the book are the Keys. They are not, as is too often the case with natural history keys, so extremely analytic and complicated that the student can only establish the identity of the specimen at the risk of losing his own. There is a short systematic Key to the Orders and Families, and under each family a Key to the Species. In the latter all systematic arrangement, in the scientific sense, is abandoned. The author's motto is: If the Keys will identify they will have accomplished their purpose. For example, the Finch family is divided into three groups:

I. Under parts with red.

II. Under parts with no red and without distinct streaks.

III. Under parts without red and with numerous streaks.

Each of these groups is again divided by other prominent color markings, until at the third sub-division the several species are reached. This plan will be found an excellent one for field identification, and by checking results with the accurate descriptions in the body of the work, all danger of error may be avoided. For some of the larger families, as the Finches and the Warbles, there is also a Field Key to the Adult Males in Breeding Plumage.

Though not too large to be carried in the pocket, the work is a gem of the art of bookmaking. In addition to upwards of 100 cuts of bills, feet, etc., scattered through the text, there is a colored frontispiece, "Bob-white," a Color Chart, and 18 full page plates in "half-

tone." The Color Chart is somewhat disappointing; what should be the brighter colors are altogether wanting in brightness. The half-tone plates, however, are all that can be desired. The Clapper Rail, Spotted Sandpiper and Young, Least Flycatcher and Phœbe, Meadowlark, and Wood and Wilson's Thrushes seem almost alive.

A. G. K.

Archæology.—NOTES ON THE ANTIQUITIES OF LAKE DESCHENES.

Along the shores of Lake Deschênes are many points of Archæological interest; and it is in the hope that some of the members of the Field Naturalists' Club may devote their time to a more special investigation of this branch of scientific research that I now call attention to some of them.

It is needless to say that the Ottawa River, of which this lake is an expansion, was, during the French régime, the great highway between the region of the great lakes and the French settlements on the St. Lawrence. Indians and "coureurs de bois" engaged in the fur trade, as well as governors of Canada, either in voyages of discovery or expeditions against their Indian enemies, traversed the waters of this river. It was at times, also, the objective point of war parties of hostile Iroquois, who, after the subjugation of their Huron kinsmen, carried the tomahawk, in a war of extermination, far into the wilds to the north of the Ottawa.

Some of the descendants of the Indians and voyageurs who took part in these stirring scenes, connected with the pioneer days of New France, are now living in Aylmer and vicinity; and it would be well to secure from them the traditions and stories attaching to points of local interest before the present generation passes away.

On the Ontario shore of the lake, at Raymond's point opposite Aylmer, is the site of an old Indian workshop where flint weapons have been fabricated. My attention was first called to it, some time ago, by Jacob Smith of the Interior Department, its discoverer. Mr. Smith shewed the writer some flint arrow heads, and a spear head of the same material, which he had discovered at this place.

Narcisse Noel of Aylmer, in company with the writer, also found some imperfect arrow-heads at this place, which appear to have been rejected by the ancient workmen. For about 100 yards along the shore, between high and low water mark, the rocks are littered with chips and shreds of black flint, which are also washed out of the gravel at high water mark after heavy rains. These flints resemble those found in great abundance in the Trenton limestone at Hull, from which place it is just possible they may have been taken. It is said that these flint chips have also been found on Snake Island a short distance from here, so that this locality seems to offer opportunities to the archaeologist that should not be overlooked.

Some years ago a quantity of human bones was found buried in the sand on the Light-house Island just above Aylmer, which the late Dr. C. M. Church, to whom tney were presented, regarded as typical of the North American Indian.

A short time ago, at Pointe a la Bataille about 10 miles above Aylmer on the Ontario shore of the lake, Joseph Leclaire of Aylmer discovered a large "cache" of bullets. As Mr. Leclaire bought home nearly half a bagfull without exhausting the find, it does not appear credible that so large a quantity of ammunition could have been "cached" by hunters; but, judging from the name of the place, one inclines rather to the supposition that this store had some connection, in the past, with the movements of war parties, either white or Indian, operating along the lake.

An interesting tradition, told by the old "voyageurs" now living in Aylmer, is associated with Lapoté's and Sand Points lying respectively to the east and west of Sand Bay at the mouth of Constance Creek about 15 miles above Aylmer The tradition is a follows: Many years ago, during the French règime, a party of "coureurs de bois" were encamped at the former point; while Sand Point to the west of the bay was occuied by a superior force of Indians, probably a war party of hostile Iroquois. An encounter was imminent and it remained to be seen which party would circumvent the other The French fur traders, whose daring and brilliant exploits at this period are a matter of history, were not to be taken by surprise Leaving their camp fires

burning on the high rocky shore at Lapoté's Point, to deceive their wily enemies, the little band of intrepid Frenchmen traversed the forest to the east of the bay, forded Constance Creek, passed beneath the shadow of the pine groves on the sand hills to the north of the bay and fell suddenly on the Indian camp on Sand Point. The encounter was sharp and terrific and resulted in the utter defeat and route of the Indians.

Wm. Baillie, of Aylmer, informed the writer that a great many bones are scattered over this point; and Mr. Montgomery, who recently lived in the vicinity, stated that his two sons discovered, at this place, an almost perfect human skeleton. Mr. Baillie also states that some years ago, on the eastern shore of the bay, a number of copper kettles, of ancient design, were unearthed. These facts would seem to corroborate, to some extent, the above tradition and invite a closer investigation of the subject. The weird Indian legends of prolonged conflicts with Wendigoes, supposed to have inhabited the sand dunes of Sand Point, should also be collected before the generation of old men, now retaining them, have passed away.

The old Indian portage at the Chats should also be a point of great interest to the archæologist. The remains of old bullets, badly decayed, have been found by the writer in the crevices of the rocks at this place, strongly suggestive of the times when these "carrying places" were disputed, foot by foot, by hostile war parties. An old copper coin and other ancient works of art, found on the lake shore at Aylmer, as well as an iron tomahawk of peculiar design discovered by S. H. Edey some two miles inland from this place, are matters of interest.

Finally, I might say that members of the Field Naturalists' Club who wish to make a careful examination of places alluded to in the above will soon be in a position to do so. Capt. Davis will shortly have a steamboat running between Britannia and the Quyon, which will enable us to make any of these places the objective point of an excursion of the club. Traditions and folk-lore stories associated with Lake Deschenes should then be collected and recorded before the hand of time has placed them beyond our reach.

T. W. EDWIN SOWTER.

Aylmer, Que.,
July 29th, 1895.

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CRYSTALS.*

By W. F. FERRIER, B.A.Sc., F.G.S. Lithologist to the Geological Survey of Canada.

I have nothing original to offer you on this subject, nor are my remarks intended to constitute a lecture on crystallography, but merely to bring to your notice some interesting facts with regard to those wonderful forms which we call crystals, and more especially to trace out the progress made in the study of them since the earliest times. The subject is so vast that it will only be possible for me to call attention to some of the more prominent and interesting facts, which constitute, as it were, the milestones along the road of our knowledge of the subject.

At the outset we are confronted with the question "What is a crystal?"

So many definitions have been given that it is somewhat difficult to select one which is expressed in simple terms and at the same time is comprehensive and accurate.

E. S. Dana says:—"Structure in Inorganic nature is a result of mathematical symmetry in the action of cohesive attraction. The forms produced are regular solids called *crystals*; whence morphology is, in the Inorganic kingdom, called CRYSTALLOLOGY. It is the science of structure in this kingdom of nature."

He subdivides the subject as follows:—

Crystallology	Crystallography	treating of forms resulting from crystallization.
	Crystallogeny	treating of the methods of making crystals, and the theories of their origin.

* (Read before the Ottawa Field Naturalists' Club, Dec. 20th. 1894.)

Naumann's definition of a crystal is a very concise and satisfactory one. It is this :—"Any rigid inorganic body possessing an essential and original (primitive) more or less regular polyhedric (many-sided) form *which is directly connected with its physical properties*."

This latter clause of the definition is very important as explaining why cleavage fragments, pseudomorphs &c. are not to be termed crystals.

To the question *why* calcite, for instance, should assume one form of crystal, and garnet another, science can return no answer, but must content itself with determining and describing these curious and multifarious forms.

The word "crystal" is derived from the Greek word "*κρυσταλλος*" meaning "ice". The ancients first gave this name to the variety of quartz which we call "Rock-crystal," because, from its transparency, its usual freedom from color, and the way in which it was found to enclose other bodies, they imagined it had been formed by the action of intense cold on water, which thus became extraordinarily hardened.

The name was later transferred to pure transparent stones, such as were after used for seals and engraved gems.

Some of the old writings on this subject are very amusing. Albertus Magnus, in the middle of the 13th century, gravely relates how the intense cold on the summits of some lofty mountains *dries* the ice so thoroughly that it becomes crystal. Even as late as 1672 the learned Robert Boyle goes into a long dissertation to prove that crystal could not be ice, adducing as two of the strongest proofs of this, first, the fact that ice floats on water and crystal does not, and, secondly, that Madagascar, India, and other countries in the torrid zone, abound in crystal, and he could not believe that any ice, however hard, could withstand the heat of those countries. Later the term "crystal" was applied to any mineral naturally limited by plane faces.

It was not until 1669 that any important discovery regarding the properties of crystals was made, and then it was that Nicolaus Steno, a Danish physician, discovered for the first time the constancy of angles in Rock-crystal. But it is generally admitted that Steno himself did not fully grasp the importance of his dis-

covery, which was more a deduction from the mathematical form of the particular body he observed than a broad generalization from a series of observations of different bodies. It must be borne in mind that the ancients knew and had described crystals of certain minerals as having a *constant number* of faces (or planes) arranged in a *particular way*. But Steno went further than this and shewed that another constant existed. He cut a number of sections of variously shaped prisms of quartz (1.) at right angles to the edges of the prism, and (2.) at right angles to the edge formed by a face of a pyramid with a face of the prism and found in the first case (see Fig. 1) that the angles of any one section were equal to each

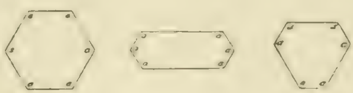

Fig. 1.

other and also to every angle of the other similar sections, and in the second case (see Fig. 2) he found that the sections had two angles equal

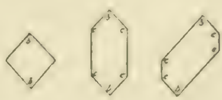

Fig 2.

to *b* and four angles equal to *c*, except when the prism was absent in the crystal, when the section was a four-sided figure with two opposite angles equal to *b*, as shewn on the left in Fig. 2.

His inference was that in all specimens of Rock-crystal corresponding pairs of faces have the same inclination.

Thus was taken the first step towards the discovery of one of the three great fundamental laws governing the formation of crystals, which has been enunciated thus :—

THE LAW OF CONSTANCY OF ANGLES. Crystals of the same substance, whether natural or formed in the laboratory, are essentially constant in the angle of inclination between like planes.

For a whole century the law discovered by Steno was not elaborated until,

in the year 1772, Romé Delisle, a pupil of Linnæus, shewed that the various shapes possessed by crystals of the same substance, natural or artificial, are all intimately related to each other. He formed a large collection of natural crystals which he carefully studied and was particularly interested by the fact that the same mineral often occurred in widely different forms. His studies led him to the conclusion that the shape of every crystal of the same substance is such as can be derived by a particular process from a certain fundamental figure called the *Primitive Form*, the shape and angles of which depend only on the nature of the subs- tance itself. All the multitudinous forms which a substance such as pyrite (sulphide of iron) assumes, he found could be produced by replacing the edges or the solid angles of the primitive form by single planes or groups of planes, but always in such a manner that the total alteration is similarly related to all parts of the primitive form which are geometrically similar.

Thus, as a simple example, by cutting off the angles of a cube it may be converted into an octahedron. These planes of replacement were regarded by him as being secondary and more or less accidental.

Werner in his treatise "On the External Characters of Minerals" had employed the terms *Abstumpfung* = truncation, *Zuscharfung* = bevelling, *Zuspitzung* = acumination, in speaking of similar variations or changes from the fundamental form of crystal, but it is thought that Delisle did not know of this at the time he wrote. Delisle set to work to determine the primitive forms of all substances, which work was greatly facilitated by the invention at this time of the goniometer. This instrument was invented by a Frenchman named Carangeau, who prepared the clay-models used by Delisle to illustrate his theory. It was designed for the measurement of solid angles, particularly those of crystals, and was of the form known as the common or *contact goniometer*.

A much more elaborate and accurate instrument for the same purpose is the *reflecting goniometer* of Dr. Wollaston, devised by him in 1809, of which several elaborate modifications are now employed by crystallographers. Carangeau's goniometer consisted essentially of a graduated arc and two moveable arms. Its form may be learned by referring to the figures given in almost all text-books of mineralogy. The great

objection to it is that it is impossible to employ it in the case of very small crystals, whilst the reflecting goniometer may be used to measure accurately the angles of crystals only $\frac{1}{100}$th of an inch in size.

Romé Delisle, as the result of his researches, came to the conclusion that the primitive forms of all known substances were only six in number, namely :—

1. The cube.
2. The regular octahedron.
3. The regular tetrahedron.
4. The rhombohedron.
5. The octahedron with a rhombic base.
6. The double six-sided pyramid.

These were announced in his treatise on Crystallography published in 1783, in which he figures no less than 500 distinct forms of crystals.

The weak point of his theory was the fact that the whole series of forms of any one substance could be derived not only from the *primitive form*, but from almost any of the series, thus rendering it impossible to lay down an exact rule as to which of these was to be regarded as the true primitive form. He was guided in his choice by the largeness of development and frequency of occurrence of particular faces and the simplicity of the figure they formed. Thus he chose both cube and regular octahedron, although, as we now know, these forms really belong to one and the same series and may be derived the one from the other. Many of his contemporaries doubted not only his choice of primitive forms but the very existence of the series, and Buffon's objections, as set forth in his "Natural History of Minerals" published ten years later (1783), bore testimony to the difficulty of the important step taken by Romé Delisle. It was far from being obvious that all the crystalline forms of a mineral belong to one series.

As early as 1773, Bergman, a celebrated Swedish chemist, shewed in his writings that he recognized the importance of cleavage, and by it he tried to explain the relationship of the various forms assumed by the same mineral, which had so interested and puzzled Delisle, who, however, assigned little or no importance to cleavage, speaking, as he does in the preface to his treatise mentioned above, most contempt

uously of the "*brise-cristaux*" or "crystalloclastes." But Bergman did not proceed far enough, and it remained for another to fully develop the theory of the structure of crystals as indicated by their cleavage.

In 1784 the Abbé Haüy made his remarkable discovery, which, like Newton's immortal one, was the result of a mere accident.

A six-sided prism of calcite (carbonate of lime) had been broken from a large group in the cabinet of M. Defrance, and he noticed that the fractures were smooth and polished, not irregular as in the case of ken glass. He then commenced splitting-up the crystal with his knife and finally reduced the six-sided prism to a rhombohedron Extending his experiment to other minerals Haüy arrived at the con clusion that the kernel obtained from a mineral by cleavage was to be regarded as its true primitive form.

E. S. Dana defines *cleavage* as the tendency to break or cleave along certain planes due to regularity of internal structure and fracture, produced, in addition to external symmetry of form, by crystallization; and he states two principles :—

(1) In any species, the direction in which cleavage takes place is always parallel to some plane which either actually occurs in the crystals or *may* exist there in accordance with certain general laws.

(2) Cleavage is uniform as to ease parallel to all like planes. That is to say that if it may be obtained parallel to *one* of the faces of a regular octahedron, for instance, it may be obtained with the same facility parallel to each of the remaining octahedral faces.

Haüy's primitive forms were ten in number, four more than those of Romé de l'Isle. They were :—

The cube.

2. The regular octahedron.

3, The regular tetrahedron.

4. The rhombic dodecahedron.

5. The rhombohedron, obtuse or acute.

6. The octahedron, with square, rectangular, or rhombic base.

7. The four-sided prism, with edges at right angles to the base, the base being either a square, a rectangle, a rhomb, or merely a parallelogram.

8. The four-sided prism, with edges inclined obliquely to the base, the base being either a rectangle, a rhomb, or merely a parallelogram.

9. The regular six-sided prism,

10. The double six-sided pyramid.

He also grouped all these forms in a general way thus:—

1. Figures bounded by parallelograms.
2. Figures bounded by eight triangles.
3. The regular tetrahedron.
4. The regular six-sided prism.
5. The double six-sided pyramid.

Hauy was let by his study of cleavage to frame a theory regarding the *structure* of crystals and to discover a second great law governing their formation, namely the one which connects the secondary faces with those of the primitive form.

He found that the kernels which he obtained by cleavage could be split up,apparently indefinitely, into smaller fragments of the same shape, and, not believing that this process could go on to infinity, came to the conclusion that every crystal of the same substance could, theoretically at least, be cleaved into minute bricks of a definite size and shape though two small to be separately visible, and therefore that with these bricks a crystal possessing any of the forms in which the particular mineral occurs, might be built up.

As the simplest illustration take the case where the bricks are little cubes The conditions to be produced are that the built-up crystal must possess cleavage, and at all its parts the faces obtainable by cleavage are to have the same directions, also that its outer surface must consist of a series of plane faces.

A cube composed of these little bricks could be increased indefinitely in size by adding layers of these bricks to each of its faces. Conversely, it might be decreased in size by taking away the layers.

But suppose that the decrease takes place by the regular subtraction of one or several ranges of bricks in each successive layer; theory, by calculating the number of these ranges required for a particular form, can represent all known forms of crystals and also indicate *possible* forms for a particular mineral which may not yet have been observed in th

natural crystals. Figs. 3 and 4 will serve to illustrate what we have just been discussing.

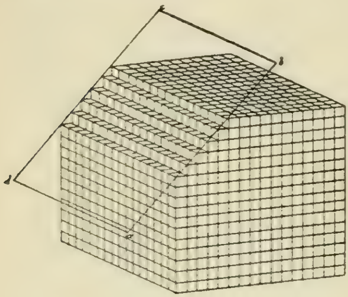

Fig. 3.

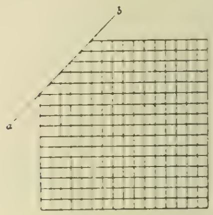

Fig. 4.

Fig. 3 illustrates a cube composed of little cubical bricks, some rows of which are removed to shew the resulting step-like arrangement of the layers. All the edges of the steps lie in one plane, as seen in Fig. 4.

If we remember that the little bricks are supposed to be so minute as to be separately invisible, it will be seen that the steps will appear to lie wholly in the plane, which thus forms a secondary face equally inclined to two faces of the cube.

Haüy also shewed how a rhombic dodecahedron resulted from the application of successive layers of these little bricks, each less by one row all round, to the faces of the primitive cube, and of course the same result may be obtained by subtracting rows in the same manner. (See Fig 4.)

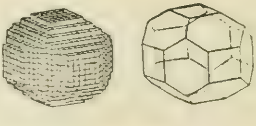

Fig. 5.

He also assumed in some cases that the decrease was parallel, not to the edges of the crystal, but to a diagonal, taking the angles as its point of departure. His theory established the fact that the various

forms of crystals are not irregular or accidental, but definite, and based on certain fixed laws; and he pointed out that whilst certain forms are derivable from a given nucleus, there are others which cannot occur.

Moreover he observed that when any change in a crystal took place by its combination with other forms, all similar parts (angles, edges and faces) were modified in the same way. Most important of all, he shewed that these changes could be indicated by *rational* co-efficients.

Thus Haüy became the discoverer of two of the three great laws of crystallography, namely, THE LAW OF SYMMETRY, and THE LAW OF WHOLE NUMBERS. The other, THE LAW OF CONSTANCY OF ANGLES, we have already mentioned.

Let us consider for a moment Haüy's two laws, taking first :—

THE LAW OF SYMMETRY.

E. S. Dana enunciates this as follows: "The symmetry of crystals is based upon the law that either:

> *I. All parts of a crystal similar in position with reference to the axes are similar in planes or modification*, *or*
>
> *II. Each half of the similar parts of a crystal, alternate or symmetrical in position or relation to the other half, may be alone similar in its planes or modifications.*

The forms resulting according to the first method are termed *holohedral* forms and those according to the second, *hemihedral*."

An easy experimental way of studying the symmetry of crystals is to cut one, or the model of one, in two, and place the parts against the surface of a mirror, which may or may not produce the *exact* appearance, of the original crystal. If it does produce the *exact* appearance we have severed the crystal in *a plane of symmetry*. By referring to Fig. 6 it will readily be seen that a cube, for instance, possesses *nine* such planes, indicated by the dotted lines.

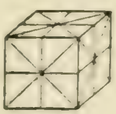

Fig. 6.

In a sphere there would of course be an infinite number of these planes.

Now with regard to the second law :—

THE LAW OF WHOLE NUMBERS. The meaning of this is simply that Haüy found that the secondary faces had only such positions as would result from the omission of *whole* numbers of rows of bricks and from the layers having a thickness measured by some multiple of that of a single brick. He actually proved by measurements that the number of bricks in the width or height of a step rarely exceeds six But Haüy's theory of the structure of crystals had many weak points in it which speedily became objects of attack. One of his first critics was Weiss, Professor of Mineralogy at Berlin, who translated Haüy's work into German, in 1804.

He shewed that Haüy's "primitive forms," as professor Nichol puts it, "erred both in excess and defect," and that the "bricks" were not needed at all to explain the facts observed, in fact, the planes, so-called, built up of them, would not reflect light.

Bernhardi, a doctor residing in Erfurt, pointed out that the dimensions of the "primitive forms" could not be determined from themselves, their height depending on another form. Also that various crystals, which he named, were much more readily explained from other forms than those taken by Haüy as their "primitives". In fact, numberless objections were raised ; thus, it by no means follows that because a crystal may be reduced to a certain form by cleavage, that its growth has resulted from the grouping together of fragments having that form : again, some minerals have no cleavage, whilst others cleave only in one or two directions ; again, it is hard to conceive of a crystal built up, for instance, of little octahedrons, which, in order to have their faces parallel to the cleavages of the resulting crystal, and be parallel to each other, would have only their angular points in contact, thus forming a most skeleton-like and unstable structure.

But Haüy's theory, pointing as it did to the great importance of the angles of the faces and cleavages of crystals, served to direct attention to them, and led to their more accurate study and determination.

It was not so much Haüy's data that required correction, but the substitution of a better theory to connect his facts was needed.

The development of the atomic theory of the constitution of

matter furnished this, and, instead of "bricks", we reason about "atomic groups," whose centres of mass are arranged in straight lines and parallel planes, as were the centres of the "bricks" in Haüy's original theory.

Weiss was the first, in 1808, to point out the importance of the axes of crystals, although Haüy had referred to them.

He says:—"The axis is truly the line governing every figure round which the whole is uniformally disposed. All the parts look to it, and by it they are bound together as by a common chain and mutual contact." These axes, it must be borne in mind, are not mere geometrical lines; but it is in reference to them that the forces work which have formed the crystals.

Weiss proceeded to arrange Hauy's *primitive* forms into four classes, each distinguished by a purely geometrical character; and then from these four classes of sets of lines, he deduced all the *primitive* forms by the construction of planes passing:—

1. Through ends of three lines.

2. Through ends of two of the lines and parallel to the third.

3. Through an end of one of the lines and parallel to two of them

That is, these planes passed through the end of a line, or else did not meet it at all. These axes were, in fact, the co-ordinates of the crystal faces of the *primitive* forms of Hauy. By taking points along each of these lines at distances equal to twice, three times, four times, etc., the original length, he found, constructing planes as before, that he obtained a set including all the *secondary* planes described by Hauy as occurring in actual crystals.

Thus he was enabled to devise a very simple system of designating the various faces of crystals, which also greatly facilitated the calculation of their angles.

Hauy had attempted this in conformity with his theory, but his symbols were complex and unwieldy.

It is a curious coincidence that at the same time as Weiss was developing his system, Mohs, Werner's successor at Freiberg, working quite independently, arrived at the same division of crystals into four classes, but by a very different process of reasoning. These four classes he termed "Systems of Crystallization."

Mohs also shewed that since all the similar edges and solid angles of his fundamental figures were to be similarly altered, the existence of one derived plane necessitated, as in Romé Delisle's theory, the simultaneous existence of a number of others having definite positions. Such a set of faces he called a *simple form*. If the faces of more than one simple form are present, the resulting form was termed a *combination*.

At this time Sir David Brewster was engaged in his wonderful researches on the optical properties of crystals, and the results of his experiments on the polarization of light brought out in such a remarkable manner the intimate relations existing between their behaviour with regard to light passing through them, and the number of kinds of axes they possessed, that Whewell has justly said, "Sir D. Brewster's optical experiments must have led to a classification of crystals into the above systems, or something nearly equivalent, even if the crystals had not been so arranged by attention to their forms."

Sometimes crystals were observed by both Weiss and Mohs which, instead of being complete simple forms, like the regular octahedron, presented only *half* the regular number of faces, as, for example, the regular tetrahedron, which may be derived from the regular octahedron by suppressing its alternate faces. Delisle and Haüy had regarded the tetrahedron as a distinct kind of primitive form, but Weiss and Mohs found it necessary to postulate that simple forms may not only be complete, but semi-complete also, pointing out, however, that the half which presents itself is not an arbitrary one, but can always be derived systematically from the complete simple form.

The complete simple forms were termed *holohedral*, and the semi-complete ones *hemihedral*.

In 1822, Mohs added two more systems of crystallization to the four already described by Weiss and himself; but Weiss brought forward very strong objections to their recognition, and their independance was not fully established until 1833, when the actions on light of crystals belonging to these systems were first studied. They were what we now call the *monoclinic* and *triclinic* systems.

The researches of Weiss and Mohs may be said to have given to

crystallography its present form, in all essential points, as a pure science, and subsequent progress has been along the lines of working out details rather than modifying its foundations.

The accompanying table, (page 130), will shew at a glance the six systems of crystallization now recognized, with their principle synonyms and examples of minerals for each system.

Very often crystals are met with in which one or more parts are reversed with regard to the others, often presenting the appearance of two crystals symmetrically united. These are termed *twin crystals*, but the theory of their formation is too elaborate to be gone into in the present paper. Time will not permit me, either, to go into details respecting the various methods of designating the faces of crystals by numbers or symbols, and of calculating their angles. That of Naumann is, perhaps, the one most employed. This subject belongs, however, more to pure geometric crystallography, and will be found fully explained in the text-books. I can only briefly mention here some of the many wonderful physical properties possessed by crystals.

The researches of Brewster on polarized light have already been referred to. The discovery that the shape of the cleavage form is intimately related to the action of the crystal upon light is due to him; and his researches, as already mentioned, confirmed the existence of the two additional systems of crystallization recognized somewhat doubtfully by Mohs.

One of the most remarkable discoveries of recent times was the mathematical demonstration by von Lang, Quenstedt, and others, that six, and *only* six, systems of symmetry are possible for all crystallized matter.

In 1822, Mitscherlich announced his discovery of *isomorphism*, the property which substances analogous in chemical composition possess of crystallizing in forms closely resembling each other, and with only a slight difference between their corresponding angles. A good example is siderite and dolomite, the crystal form being a rhombohedron. Mitscherlich also pointed out that the same substance (simple or compound) may crystallize in two distinct systems *(dimorphism)*, or even in three or more *(trimorphism* and *polymorphism)* Thus the sulphide of iron crystallizes in the isometric system *(pyrite)*, and also in the orthorhombic system (*marcasite*).

SYSTEMS OF CRYSTALLIZATION.

NAME.	AXES.	PLANES OF SYMMETRY.	EXAMPLES.
I. ISOMETRIC.— *Tessular*, Mohs & Haidinger. *Isometric*, Hansmann. *Tesseral*, Naumann. *Regular*, Weiss & Rose. *Cubic*, Dufrenoy & Miller. *Monometric*, Dana (early editions.)	Three, of equal length, intersecting each other at right angles.	Nine.	Fluor Spar. Galena. Pyrite.
II. TETRAGONAL.— *Pyramidal*, Mohs. *Zwei-und-einaxige*, Weiss. *Tetragonal*, Naumann. *Monodimetric*, Hausmann. *Quadratic*, von Kobell. *Dimetric*, Dana (early editions)	Three, intersecting each other at right angles. The lateral ones equal in length; the vertical a varying one	Five.	Zircon. Vesuvianite. Cassiterite.
III. HEXAGONAL. *Rhombohedral*, Mohs. *Drei-und-einaxige*, Weiss. *Hexagonal*, Naumann. *Monotrimetric*, Hausmann. NOTE.—This System has a RHOMBOHEDRAL DIVISION, which includes forms with only 3 planes of symmetry.	Four, the three equal lateral ones intersecting at angles of 60° and the vertical one, at right angles to these, varying in length.	HEX. proper. Seven; 3 at 60°; one normal to these; three auxiliary. RHOM. DIV Three at 120°.	Calcite. Quartz. Apatite.
IV. ORTHORHOMBIC.— *Prismatic* or *Orthotype*, Mohs. *Ein-und-einaxige*, Weiss. *Rhombic* and *Anisometric*, Naumann. *Trimetric* and *Orthorhombic*, Hausmann. *Trimetric*, Dana, (early editions.)	Three, of unequal length, intersecting each other at right angles.	Three, at right angles to each other.	Barite. Topaz. Aragonite.
V. MONOCLINIC.— *Hemiprismatic* and *Hemiorthotype*, Mohs. *Zwei-und-eingliederige*, Weiss. *Monoclinohedral*, Naumann. *Clinorhombic*, von Kobell, Hausmann, Des Cloiszeaux. *Augitic*, Haidinger. *Oblique*, Miller. *Monosymmetric*, Groth.	Three, of unequal length, two intersecting at right angles and the third intersecting one of the others obliquely.	One.	Augite. Gypsum. Orthoclase.
VI. TRICLINIC.— *Tetarto prismatic*, Mohs. *Ein-und-eingliederige*, Weiss. *Triclinohedral*, Naumann. *Clinorhomboidal*, von Kobell. *Anorthic*, Haidinger, Miller, & Des Cloiszeaux. *Asymmetric*, Groth.	Three, of unequal length, all the intersections oblique.	None.	Anorthite. Albite. Cyanite.

The magnetic and electric properties of crystals, and their relations to heat, all shew the same intimate connection and dependence on their crystalline form observed in the case of their optic properties

For fuller details of the subject treated of in this paper I would refer you to the many excellent text-books of mineralogy, and to the articles treating of the various divisions of the subject in the encyclopædias. A most excellent little work is that by Mr. Fletcher of the British Museum, from which I have freely quoted.

In conclusion I would call your attention to the fact that we Canadians have in our own country a vast unexplored field of research in crystallography. Canada has afforded the most magnificent crystals of many mineral species, which the world has ever seen. I need only mention the superb and unrivaled crystals of zircon, apatite, phlogopite, sphene &c. which grace the museums of Europe and this continent.

Many of our localities present unusually favorable conditions for studying the mode of formation of the various crystallized minerals, and if my remarks this evening awaken in some of my hearers an interest in the fascinating study of the wonderful laws governing structure in inorganic nature, my object will be accomplished.

CLUB EXCURSION TO PAUGAN FALLS.

The last Excursion of the season will be held on SATURDAY, 14th instant, to PAUGAN FALLS, on the Gatineau. The train will leave Union Station at 9.45 a.m.; returning, reaching Ottawa at 8.00 p.m.

This is a new locality to members of the Club, and must prove of great interest, both as a collecting ground, and from its scenic beauty.

Members will assist the Club by notifying their friends of the Excursion.

RATES—Members, Adults, 60c. Non-Members, 70c. Children, half-price.

LIST OF NATIVE TREES AND SHRUBS GROWING AT THE CENTRAL EXPERIMENTAL FARM, OTTAWA, JULY, 1895.

By W. T. MACOUN.

For the first part of this Paper, see August number of the OTTAWA NATURALIST.

SAPINDACEÆ,—(continued.)

(419) ACER NIGRUM, Michx.
Ontario.
Large tree ; hardy.

(420). A. DASYCARPUM, Ehrh. Silver, or White Maple.
N.B. ; Que. ; Ont.
Large tree ; hardy ; leaves ornamental in Autumn.

(421.) A. RUBRUM, Linn. Red, or Soft Maple.
Large tree ; hardy ; leaves ornamental in Autumn.

126. NEGUNDO, Mœnch. (Ash-leaved Maple.)
(422.) N. ACEROIDES, Mœnch. Box-Elder.
Ont. ; Man ; N.W.T.
Tree ; hardy.

XXX. ANACARDIACEÆ—Sumach Family.

127. RHUS, Linn. (Sumach.)
(423.) R. TYPHINA, Linn. Stag-horn Sumach.
N.S ; N.B. ; Que. ; Ont.
Tall shrub or small tree ; hardy ; leaves ornamental in autumn.

(424) R. GLABRA, Linn. Smooth Sumach.
N.S. ; N.B. ; Que. ; Ont.
Tall shrub ; hardy.

(427.) R. TOXICODENDRON, Linn. Poison Ivy.
N.S. ; N.B. ; Que. ; Ont. ; Man. ; N.W.T. ; B.C.
Small climbing shrub ; hardy.

(429.) R. AROMATICA, Ait. Fragrant Sumach.
Ont.
Shrub ; hardy.

VAR. TRILOBATA, Gray.
N.W.T. ; B.C.
Shrub ; hardy.

XXXI. LEGUMINOSÆ—Pea Family.

138. AMORPHA, Linn. (False Indigo.)
(480.) A. CANESCENS, Nutt. Lead Plant.
Man.
Shrub ; hardy.

(481.) A. FRUTICOSA, Linn. False Indigo
Man.
Shrub ; hardy.

153. GYMNOCLADUS, Lam. (Kentucky Coffee Tree.)
(566.) G. CANADENSIS, Lam.
Western Ontario.
Large tree ; hardy.

XXXII. ROSACEÆ Rose Family.

155. PRUNUS, Tourn. (Plum. Cherry.)
(568.) P. AMERICANA, Marshall. Wild Plum.
Que. ; Ont. ; Man.
Small tree ; hardy.

(569.) P. MARITIMA, Wang. Beach Plum.
N. B. ;
Shrub ; hardy.

(570.) P. PUMILA, Linn. Sand or Dwarf Cherry.
N.B. ; Que.; Ont.; Man.
Shrub ; hardy.

(571.) P. PENNSYLVANICA, Linn. Bird Cherry.
N.S. ; N.B. ; Que. ; Ont. ; Man. ; N.W.T. ; B.C.
Tree ; hardy.

(573.) P. VIRGINIANA, Linn. Choke Cherry.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.
Tall shrub, or small tree; hardy.

(575.) P. SEROTINA, Ehrh. Black Cherry.
N.S.; N.B.: Que.; Ont.
Tree; hardy.

157. SPIRÆA, Linn. (Meadow-sweet.)

(577.) S. SALICIFOLIA, Linn. Common Meadow-sweet.)
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.
Shrub; hardy; flowers ornamental.

(578.) S. TOMENTOSA, Linn. Hardhack. Steeple Bush.
N.S.; N.B.; Que.; Ont.
Shrub; hardy; flowers ornamental

(579.) S. BETULIFOLIA, Pallas. Birch-leaved Spiræa.
N.W.T.; B.C.
Shrub recently planted.

(580.) S. DOUGLASII, Hook.
B.C.
Shrub; hardy; flowers ornamental.

(581.) S. DISCOLOR, Pursh. var. ARIÆFOLIA, Watson.
B.C.
Shrub; hardy.

158. NEILLIA, Don. (Nine Bark.)

(584.) N. OPULIFOLIA, Benth. and Hook.
Que.; Ont.
Shrub; hardy.

160. RUBUS, Tourn. (Bramble.)

(586.) R. ODORATUS, Linn. Purple, Flowering Raspberry.
N.S.; N.B.; Que.; Ont.
Shrub; hardy; flowers ornamental.

(587.) R. NUTKANUS, Mocins. White, Flowering Raspberry.
Ont.; Man.; N.W.T.; B.C.
Shrub; hardy; flowers ornamental.

(594.) R. STRIGOSUS, Michx. Red Raspberry.
N.S. ; N.B. ; Que. ; Ont. ; Man. ; N.W.T. ; B.C.
Shrub ; hardy.

(596.) R. OCCIDENTALIS, Linn. Black Raspberry.
N.B. ; Que. ; Ont.
Shrub ; hardy.

(600.) R. VILLOSUS, Ait. Thimble Berry.
N.S. ; N.B. ; Que. ; Ont.
Shrub ; hardy.

172. ROSA, Tourn. (Rose.)

(659.) R. SETIGERA, Michx.
Ont.
Shrub ; hardy ; flowers ornamental.

(660.) R. CAROLINA, Linn. Swamp Rose.
N.S. ; N.B. ; Que. ; Ont.
Shrub ; hardy ; flowers ornamental.

(661.) R. LUCIDA, Ehrh. Dwarf Wild Rose.
N.S. ; N.B. ; Que. ; Ont.
Shrub ; hardy ; flowers ornamental.

(662.) R. BLANDA, Ait. Early Wild Rose.
Que. ; Ont. ; Man. ; N.W.T. ; B.C.
Shrub ; hardy ; flowers ornamental.

(663.) R. ACICULARIS, Lindl.
Man.; N.W.T.
Shrub ; hardy ; flowers ornamental.

173. PIRUS, Linn. (Pear. Apple.)

(671.) P. CORONARIA, Linn. American Crab Apple.
Ont.
Small tree ; hardy.

(673.) P. ARBUTIFOLIA, Linn. Choke-berry
N.S. ; Que. ; Ont. ;
Shrub ; hardy.

VAR. MELANOCARPA, Hook.

N.S.; N.B.; Que.; Ont.

Shrub; hardy.

(674.) P AMERICANA, DC. American Mountain Ash.

N.S.; N.B.; Que.; Ont.; Man.

Small tree; hardy; fruit ornamental.

174. CRATÆGUS, Linn. [White Thorn.]

[678.] C. COCCINEA, Linn. Scarlet Fruited Thorn.

N.S; Que.; Ont.; Man.; N.W.T.

Small tree; hardy; fruit ornamental.

[679.] C. TOMENTOSA, Linn. Black or Pear Thorn.

N.S.; N.B.; Que.; Ont.

Small tree; hardy.

[681.] C. CRUS-GALLI, Linn. Cockspur Thorn.

Western Ontario.

Small tree; hardy; leaves and fruit ornamental.

175. AMELANCHIER, Medic. [June-Berry.]

[685.] A. CANADENSIS, Torr. and Gray.

N.S.; N.B.; Que.; Ont.

Tall shrub or small tree; hardy.

XXXIII. SAXIFRAGACEÆ—Saxifrage Family,

186. PHILADELPHUS, Linn. [Mock-Orange.]

[744.] P. GORDONIANUS, Lindl.

B.C.

Tall shrub; hardy; flowers ornamental.

187. RIBES, Linn. [Currant. Gooseberry.]

[749.] R. CYNOSBATI, Linn. Wild Gooseberry.

N.B.; Que.; Ont; Man

Shrub; hardy.

[750.] R. LACUSTRE, Poir. Swamp Gooseberry,

N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.

Shrub; hardy.

[752.] R. RUBRUM, Linn. Red Currant.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.
Shrub; hardy.

[753.] R. PROSTRATUM, L'Her. Fetid Currant.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.
Low shrub; hardy.

[757.] R. FLORIDUM, L'Her. Black Currant.
N.S; N.B.; Que.; Ont.; Man.
Shrub; hardy.

[760.] R. SANGUINEUM, Pursh. Red, Flowering Currant.
B.C.
Shrub; tender; flowers ornamental.

[761.] R. AUREUM, Pursh. Missouri Currant.
N.W.T.
Shrub; hardy; flowers ornamental.

XXXVI. HAMAMELACEÆ—Witch Hazel Family.

191. HAMAMELIS, Linn. [Witch Hazel.]
[775.] H. VIRGINIANA, Linn.
N.S.; N.B.; Que.; Ont.
Tall shrub; hardy.

XLVII. CORNACEÆ—Dogwood Family.

242. CORNUS, Tourn. [Cornel. Dogwood.]
[898.] C. FLORIDA, Linn. Flowering Dogwood.
Western Ontario.
Small tree; semi-hardy; flowers and fruit ornamental.

[899.] C. NUTTALLII, Audubon. Western Flowering Dogwood.
B.C.
Small tree; recently planted; flowers and fruit ornamental.

[902.] C. STOLONIFERA, Michx. Red-osier Dogwood.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.
Shrub; hardy.

[906.] C. ALTERNIFOLIA, Linn. Alternate-leaved Cornel.
N.S.; N.B.; Que.; Ont.
Tall shrub or small tree: hardy.

XLVIII. CAPRIFOLIACEÆ—Honeysuckle Family.

245. SAMBUCUS, Linn. [Elder.]
[909.] S. RACEMOSA, Linn. Red berried Elder.
N.W.T.; B.C.
Tall shrub; hardy; fruit ornamental.

VAR PUBENS, WATSON.

N.S.; N.B.; Que.; Ont.; Man.; N.W.T.
Tall shrub; hardy; fruit ornamental.
[910.] S. CANADENSIS, Linn. Common Elder.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.
Shrub; hardy; flowers ornamental.
246. VIBURNUM, Linn. [Arrow wood.]
[912.] V. CASSINOIDES. Linn.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.
Tall shrub; hardy.
[913.] V. DENTATUM, Linn. Arrow-wood.
Ont.
Shrub; hardy; leaves oanamental.
[914.] V. PUBESCENS, Pursh. Downy Arrow-wood.
Que.; Ont.; Man.
Shrub; hardy.
[915.] V. ACERIFOLIUM, Linn. Maple-leaved Arrow-wood.
Que.; Ont.; Man.; N.W.T.
Shrub; hardy.
[917.] V. OPULUS, Linn. High-bush Cranberry.
N.S; N.B.; Que.; Ont.; Man.; N.W.T.
Tall shrub; hardy; fruit ornamental.
247. LINNÆA, Gronov. [Twin-flower.]
[919.] L. BOREALIS, Gronov. Northern Twin-flower
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.
Low creeping evergreen: shrubby: hardy; flowers ornamental.

248. SYMPHORICARPOS, Juss. [Snow-berry.]

[921.] S. racemosus, Michx. Snow-berry.

N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.

Shrub; hardy; fruit ornamental.

249. LONICERA, Linn. [Honeysuckle. Woodbine.]

[925.] L. Sullivantii, Gray. (?)

Ont.; Man.

Twining shrub; hardy; flowers ornamental.

[926.] L. glauca, Hill. Smooth Honeysuckle.

Ont.; Man.; N.W.T.

Twining shrub; hardy; flowers ornamental.

[927.] L. involucrata, Banks.

N.B.; Que.; Ont.; Man.; N.W.T.; B.C.

Shrub; hardy.

[928.] L. ciliata, Muhl. Fly Honeysuckle.

N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.

Shrub; hardy.

250. DIERVILLA, Tourn. [Bush Honeysuckle.]

[932.] D. trifida, Mœnch.

N.S.; N.B.; Que.; Ont.; Man.; N.W.T.

Low shrub; hardy.

XLIX. RUBIACEÆ Madder Family.

252. CEPHALANTHUS, Linn, [Button-bush.]

[934.] C. occidentalis, Linn. Button-bush.

Que.; Ont.

Shrub; hardy.

LV. VACCINIACEÆ--Huckleberry Family.

349. VACCINIUM, Linn.

[1355.] V. corymbosum, Linn.

N.S.; N.B.; Que.

Low shrub; hardy.

[1359.] V. Myrtillus, Linn. Whortleberry. Bilberry.

N.W.T.; B.C.

Low shrub; hardy.

Zoology.—The Scientific Results of the "Challenger Expedition. With text Illustrations and Plates II—XVII. Introduction, by E. Raya Lankester, F. R. S.

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THE OTTAWA NATURALIST.

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LIST OF NATIVE TREES AND SHRUBS GROWING AT THE CENTRAL EXPERIMENTAL FARM, OTTAWA, JULY, 1895.

By W. T. MACOUN.

Being continuation and completion of the paper which appeared in No. 5 and No. 6 of the Ottawa Naturalist for August and September, 1895.

(1364.) VACCINIUM VITIS-IDÆA, Linn. Cowberry, Cranberry.
N.S ; N.B. ; Que. ; Man. ; N.W.T. ; B.C.
Low shrub ; hardy.

353. ARCTOSTAPHYLOS, Adns. (Bearberry.)
(1370.) A. UVA-URSI, Spreng. Bearberry, Kinnikinick.
N.S. ; N.B. ; Que. ; Ont. ; Man. ; N.W.T. ; B.C.
Low Shrub ; hardy.

354. GAULTHERIA, Linn. (Aromatic Wintergreen.)
(1375.) G. SHALLON, Pursh. Salal.
British Columbia.
Shrub ; recently planted.

359. CALLUNA, Salisb. (Heather.)
(1385.) C. VULGARIS, Salisb.
N.S ; N.B.
Low shrub ; hardy.

362. KALMIA, Linn. (American Laurel.)
(1392.) K. LATIFOLIA, Linn. Calico-bush.
Reported in Labrador.
Shrub ; recently planted ; flowers ornamental.

(1393.) K. ANGUSTIFOLIA, Linn. Sheep Laurel, Lambkill.
N.S.; N.B,; Que.; Ont.
Shrub; hardy; flowers ornamental.

364. RHODODENDRON, Linn. (Rose-bay, Azalea.)
(1400.) R. VISCOSUM, Torr. Clammy Azalea.
Reported in Canada.
Shrub; hardy; flowers ornamental.

(1401.) R. NUDIFLORUM, Torr. Purple Azalea.
Reported in Canada.
Shrub; hardy; flowers ornamental.

LXI. OLEACEAE—Olive Family.

388. FRAXINUS, Linn. (Ash.)
(1455.) F. Americana, Linn. White Ash.
N.S.; N.B.; Que.; Ont.
Large tree; hardy.

(1456.) F. PUBESCENS, Lam. Red Ash or River Ash.
N.S.; Que.; Ont.; Man.
Tree; hardy.

(1457.) F. VIRIDIS, Michx. Green Ash.
Ont.; Man.
Tree; hardy.

(1458.) F. QUADRANGULATA, Michx. Blue Ash.
Western Ontario.
Large tree; semi-hardy.

(1460.) F. SAMUICIFOLIA, Lam. Black or Swamp Ash.
N.S.; N.B.; Que.; Ont.
Large tree; hardy.

LXXIII. BIGNONIACEÆ—Bignonia Family.

464. TECOMA, Juss. (Trumpet-Creeper.)
(1740.) T. RADICANS, Juss.
Western Ontario.
Woody climber; semi-hardy; flowers ornamental.

LXXXVII. LAURACEÆ – Laurel Family.

524. SASSAFRAS, Nees. (Sassafras.)
(1919.) S. OFFICINALE, Nees.
Western Ontario.
Tree ; Semi-hardy ; ornamental.

525. LINDERA, Thunb. (Wild Allspice.)
(1920.) L. BENZOIN, Meisner. Spice Bush.
Ontario.
Tall shrub ; semi-hardy, leaves and flowers ornamental.

LXXXVIII. THYMELÆACEÆ—Mezereum Family.

527. DIRCA, Linn. (Leather-wood, Moose-wood.)
(1922.) D. PALUSTRIS, Linn.
N.B. ; Que. ; Ont.
Shrub ; hardy ; ornamental.

LXXXIX. ELÆAGNACEÆ—Oleaster Family.

528. ELÆAGNUS, Linn. (Silver Berry.)
(1913.) E. ARGENTEA, Pursh.
Que. ; Ont. ; Man. ; N.W.T. ; B.C.
Tall shrub ; hardy ; leaves ornamental.

529. SHEPHERDIA, Nutt. (Shepherdia.)
(1924.) S. CANADENSIS, Nutt. Canadian Shepherdia.
N.B., Que. ; Ont. ; Man. ; N.W.T. ; B.C.
Shrub ; hardy ; fruit ornamental.

(1925.) S. ARGENTEA, Nutt. Buffalo-Berry.
Man. ; N.W.T.
Shrub ; hardy ; fruit ornamental.

XCIII. URTICACEÆ.—Nettle Family.

535. ULMUS, Linn. (Elm.)
(1946.) U. FULVA, Michx. Slippery or Red Elm.
Que. ; Ont.
Large tree ; hardy.

(1947.) U. AMERICANA, Linn. American Elm.
N.S. ; N.B. ; Que. ; Ont. ; Man. ; N.W.T.
Large tree ; hardy.

(1948.) U. RACEMOSA, Thomas. Rock Elm.
Que. ; Ont.
Tree ; hardy.

536. CELTIS, Linn. (Nettle Tree)
(1949.) C. OCCIDENTALIS, Linn. Sugar-Berry.
Que. ; Ont.
Tree ; hardy.

539. MORUS, Linn. (Mulberry.)
(1952.) M. RUBRA, Linn. Red Mulberry.
Western Ontario.
Small tree ; hardy.

XCIV. PLATANACEÆ.—Plane-Tree Family.

545. PLATANUS, Linn. (Button-Wood.)
(1963.) P. OCCIDENTALIS, Linn.
Western Ontario.
Large tree ; hardy ; leaves ornamental.

XCV. JUGLANDACEÆ.—Walnut Family.

546. CARYA, Nutt, (Hickory.)
(1964.) C. ALBA, Nutt. Shell-bark Hickory.
Que. ; Ont.
Large tree ; hardy.

(1966.) C. PORCINA, Nutt. Pig-nut or Brown Hickory.
Western Ontario.
Tree ; recently planted.

(1967.) C. AMARA, Nutt. Bitter-nut Hickory.
Que. ; Ont.
Tree ; hardy.

547 JUGLANS, Linn. (Walnut.)

(1968.) J. CINEREA, Linn. Butternut.

Que.; Ont.

Large tree; hardy.

(1969.) J. NIGRA, Linn. Black Walnut.

Western Ontario.

Large tree; hardy.

XCVI. MYRICACEÆ—Sweet Gale Family.

548. MYRICA, Linn. (Wax Myrtle.)

(1970.) M. GALE, Linn. Sweet Gale.

N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.

Shrub; Hardy.

XCVII. CUPULIFERÆ.—Oak Family.

549. BETULA, Linn. Birch.

(1974.) B. LENTA, Linn. Cherry or Black Birch.

N.S.; N.B.; Que.; Ont.

Large tree; hardy.

(1975.) B. LUTEA, Michx. Yellow Birch.

N.S.; N.B.; Que.; Ont.

Large tree; hardy.

(1977.) B. PAPYRIFERA, Michx. Canoe Birch.

N.S.; N.B.; Que.; Man.; N.W.T.; B.C.

Large tree; hardy.

(1978.) B. OCCIDENTALIS, Hooker. Western Birch.

N.W.T.; B.C.

Tree; hardy.

(1879.) B. PUMILA, Linn. Low Birch.

N.S.; N.B.; Que.; Ont.; Man.; N.W.T.

Shrub; hardy.

550. ALNUS, Gærtn. (Alder.)

(1985.) A. INCANA, Willd. Common Alder.

N.S.; N.B.; Que.; Ont.; Man.; N.W.T.

Tall shrub or small tree; hardy.

(1986.) A. VIRIDIS, DC. Green Alder.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T., B.C.
Tall shrub; hardy.

551. CARPINUS, Linn. (Hornbeam.)

(1987.) C. CAROLINIANA, Walter. Blue Beech.
Que.; Ont.
Tree; hardy.

552. OSTRYA, Scop. (Ironwood.)

(1988.) O. VIRGINICA, Willd. Lever-wood.
N.S.; N.B.; Que.; Ont.
Tree; hardy.

333. CORYLUS, Linn. (Hazel-nut.)

(1989.) C. ROSTRATA, Ait. Beaked Hazel-nut.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.
Shrub; hardy.

(1990.) C. AMERICANA, Walt. Wild Hazel-nut.
Ont.; Man.; N.W.T.
Shrub; hardy.

554. QUERCUS, Linn. (Oak.)

(1991.) Q. ALBA, Linn. White Oak.
Que.; Ont.
Large tree; hardy.

(1994.) Q, MACROCARPA, Michx. Mossy-cup Oak.
N.B.; Que.; Ont.; Man.; N.W.T.
Large tree; hardy.

(1996.) Q. PRINUS, Linn. Rock Chestnut Oak.
Western Ontario.
Tree; hardy.

(1997.) Q. PRINOIDES, Willd. Yellow Oak, Chestnut Oak.
Ontario.
Tree; hardy.

(1998.) Q. RUBRA, Linn. Red Oak.
N.S.; N.B.; Que.; Ont.
Large tree; hardy; leaves ornamental in Autumn,

(1999.) Q. COCCINEA, Wang. Scarlet Oak.
Ontario.
Large tree; hardy; leaves ornamental in Autumn.

(2000.) Q. TINCTORIA, Bartram. Yellow Oak.
Western Ontario.
Large tree; hardy.

(2001.) Q. PALUSTRIS, Du Roi. Pin Oak.
Western Ontario.
Tree; hardy

555. CASTANEA, Gærtn. (Chestnut.)
(2002.) C. VULGARIS, Var. AMERICANA, A. DC.
Western Ontario.
Large tree; hardy.

556. FAGUS, Linn. (Beech.)
(2003.) F. FERRUGINEA, Aiton. American Beech.
N.S.; N.B.; Que.; Ont.
Large tree; hardy; leaves ornamental in Autumn.

XCVIII. SALICACEÆ—Willow Family.

557. SALIX, Linn. Willow.
(2012.) S. CANDIDA, Willd. Hoary Willow.
Que.; Ont.; Man.; N.W.T.; B.C.
Tall shrub; hardy.

(2015.) S. CORDATA, Muhl. Heart-leaved Willow.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.
Tall shrub or small tree; hardy.

(2016.) S. DISCOLOR, Muhl. Glaucous Willow.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.
Tall shrub or small tree; hardy.

(2024.) S. HUMILIS, Marshall. Low Willow.
N.S.; N.B.; Que.; Ont.
Shrub; hardy.

(2028.) S. LUCIDA, Willd. Shining Willow.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.
Tall shrub or small tree; hardy; leaves ornamental.

(2048.) S. TRISTIS, Ait.
Nova Scotia.
Low shrub; hardy.

558. POPULUS, Linn. (Poplar.)
(2053.) P. TREMULOIDES, Michx. Aspen.
N.S.; N.B.; Que., Ont.; Man.; N.W.T.; B.C.
Tree; hardy.

(2056.) P. ANGUSTIFOLIA, James. Black Cottonwood.
N.W.T.
Tree; hardy.

(2058.) P. MONILIFERA, Aiton. Cottonwood.
Que.; Ont.; Man.; N.W.T.
Large tree; hardy.

CI. CONIFERÆ—Pine Family.

562. THUYA, Linn. (Arbor-Vitæ.)
(2062.) T. OCCIDENTALIS, Linn. White Cedar.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.
Tree; hardy; ornamental.

563. JUNIPERUS, Linn. (Juniper.)
(2067.) J. VIRGINIANA. Linn. Red Cedar.
N.S.; Que.; Ont.
Tree; hardy; ornamental.

(2068.) J. COMMUNIS, Linn. Common Juniper.
N.S.; N.B.; Que.; Ont.; Man.; N.W.T.; B.C.
Shrub; hardy.

564. TAXUS, Linn. (Yew.)
(2071.) T. BACCATA, L. var CANADENSIS, Gray. American Yew.
N.S.; N.B.; Que.; Ont.; Man.;
Shrub; hardy.

565. PINUS, Linn. (Pine.)

(2072.) P. Strobus, Linn. White Pine.
N.S. ; N.B. ; Que. ; Ont. ; Man.
Large tree ; hardy ; ornamental.

(2076.) P. resinosa, Aiton. Red Pine.
N.S. ; N.B. ; Que. ; Ont.
Large tree ; hardy ; ornamental.

(2077.) P ponderosa, Dougl. Heavy-wooded Pine.
British Columbia.
Large tree ; hardy ; ornamental.

(2079.) P. Murrayana, Balfour. Black Pine.
N.W.T. ; B.C.
Tree ; hardy ; ornamental.

(2080.) P. rigida, Miller. Pitch Pine.
N.B. ; Que. ; Ont.
Tree ; hardy.

566. PICEA, Link. (Spruce.)

(2082.) P. nigra, Link. Black Spruce.
N.S ; N.B. ; Que. ; Ont. ; Man. ; N.W.T. ; B C.
Tree ; hardy ; ornamental.

(2083.) P. alba, Link. White Spruce.
N.S. ; N.B. ; Que. ; Ont. ; Man. ; N.W.T.
Tree ; hardy ; ornamental.

(2084.) P. Engelmanni, Engelm. Engelmann's Spruce
N.W.T. ; B.C.
Large tree ; hardy ; ornamental.

567. TSUGA, Cass. (Hemlock.)

(2086.) T. Canadensis, Carr. Hemlock.
N.S ; N.B. ; Que. ; Ont.
Large tree ; hardy ; ornamental.

568. PSEUDOTSUGA, Carr. (Red Fir.)

(2089.) P. DOUGLASII, Carr. Douglas Fir.

N.W.T. ; B.C.

Large tree ; hardy ; ornamental.

569. ABIES, Juss. (Balsam.)

(2090.) A. BALSAMEA, Miller. Canada Balsam Fir.

N.S. ; N.B. ; Que. ; Ont. ; Man. ; N.W.T.

Tree ; hardy ; ornamental.

(2019.) A. SUBALPINA, Engelm. Mountain Balsam.

N.W.T. ; B.C.

Tree ; hardy ; ornamental.

(2083.) A. AMABILIS, Forbes. White Fir.

British Columbia.

Tree ; hardy ; ornamental.

570. LARIX, Mill. (Tamarack, Larch.)

(2094.) L. AMERICANA, Michaux Tamarack, Black Larch.

N.S. ; N.B. ; Que. ; Ont. ; Man. ; N.W.T.

Tree ; hardy ; ornamental.

EXCURSION NO. 3.

The last field day of the O. F. N. Club for the season of 1895 was held, as announced, on 14th. September. The objective point was the Paugan Falls on the Gatineau River near Low Station, about 40 miles from Ottawa.

About 120 members and friends of the club were present, but there was a dearth of leaders of sections, and owing to this cause and the rapidly advancing autumn, the collection of specimens made was unusually meagre. On the reassembling of the party in the afternoon, however, and after a short introductory address by the president, Mr. F. T. Shutt, M. A., the leaders in Botany discussed the flowers and plants collected, Mr. R. B. Whyte giving particular regard to the *compositæ* to which order as he pointed out most of the autumn flowers belonged

Mr. Craig drew attention to the number and variety of the coniferous trees standing near and made some interesting remarks upon their nature and uses.

After a short address by Mr. R. H. Cowley upon the importance of natural history studies in education, the train for home drew up, and the party reached Ottawa at 8 p. m.

GEOLOGIGAL SOCIETY OF AMERICA, SPRINGFIELD, MASS., 1895.

Abstracts and Titles of Papers Read at the August Meeting.

1. *On the Glacial Deposits of South-western Alberta, in the Vicinity of the Rocky Mountains. By George M. Dawson and R. G. McConnell, Ottawa, Canada.*

This paper presented the facts obtained during a recent examination of the glacial deposits of a portion of the south western of the Canadian Great Plains, in the foot-hills and along the base of the Rocky Mountains, where phenomena of particular interest are met with in connection with the relations of the western and eastern drift. (Cordilleran and Laurentide.) A brief summary of previous observations is followed by a description of sections along two main lines of approach to the mountains at relatively low levels and an examination of the conditions surrounding the glacial deposits at the highest levels, found in the form of terraces with rolled shingle at 5,300 feet on the Porcupine Hills. In conclusion, the observed facts are briefly discussed, attention being practically confined to the particular region treated in the body of the paper.

2. *The Champlain Glacial Epoch. By C. H. Hitchcock, Hanover, N. H.*

The Champlain was a true glacial epoch, when the land was considerably depressed. Glaciers from the north and south discharged bergs into an estuary. The fauna was arctic. Moraines and both the marine and fluviatile clays covered till of an earlier ice-sheet. It is possible to harmonize the conflicting theories of glacial and ice-berg action by referring the greater ice-sheets to the earlier, and the floating ice phenomena to the later, Champlain epoch.

3. *Drumlins and Marginal Moraines of Ice-sheets. By Warren Upham, Cleveland, Ohio.*

4. *The Glacial Genesee Lakes. By Prof. H. L. Fairchild, Rochester, N. Y.*

The direction, inclination and extent of the Genesee Valley made possible the production, during the retreat of the ice-sheet, of a succession or glacial lakes with different outlets. The paper described, with the aid of a map, (1) the present topography and hydrography of the valley, (2) the ancient drainage channels, (3) the complex lacustrine phenomena.

5. *The Archean and Cambrian Rocks of the Green Mountain Range in Southern Massachusetts. By Prof. B. K. Emerson, Amherst, Mass.*

Description of a series of Archean anticlines partly overturned and overthrust westward, and of the uniformity of the Cambrian conglomerate gneiss upon the old rocks.

6. *The Triassic in Massachusetts. By Prof. B. K. Emerson, Amherst, Mass.*

The stages of deposition and deformation of the sandstones and the relations of the effusive traps and tuffs and the intruded traps to the sandstones.

7. *Notes on Relations of Lower Members of Coastal Plain Series in South Carolina. By Mr. N. Darton, Washington, D. C.*

8. *Resume of General Stratigraphic Relations in the Atlantic Coastal Plain from New Jersey to South Carolina. By Mr. N. H. Darton, Washington, D. C.*

9. *Cretaceous Plants from Martha's Vineyard. Results Obtained from an Examination of the Material Collected by David White in 1889. By Mr. Arthur Hollick, New Brighton, N. Y.*

10. *On Asbestos and Asbestiform Minerals. By Dr. George P. Merrill, Washington, D. C.*

The paper treats of the composition, mode of occurrence and mineralogical nature of the various minerals commercially grouped under the name of asbestos, and attempts to explain their fibrous structure as due to abnormal elongation of the mineral parallel to the vertical axis, the individual fibres being in part at least by prismatic faces, that is by the planes of easiest cleavage. The primary cause of this elongation is believed to be mainly dynamical, a result of shearing and other earth movements such as are productive of uralitic hornblendes, schistosity or even slaty structure and slickensided surfaces, where actual fracturing takes place.

11. *Pre-Cambrian Volcanoes in Southern Wisconsin. By Prof. Wm. H. Hobbs, Madison, Wis.*

A preliminary report on the study of a group of isolated areas of igneous rocks which protrude through the Potsdam sandstone in the valley of the Fox River, Wisconsin. Some of these areas represent local outflows of rhyolitic lava which exhibits superb examples of spherulitic, peritic, fluxion, and breccia structures. The originally glassy ground mass of these rocks has become devitrified—hence they are aporhyolites, and they have been subjected to dynamic metamorphism and subsequent infiltration of silica. They are intruded by dikes of both basic and acid rocks. Specimens and photographic sections were exhibited.

12. *A Geological Sketch of the Sierra Tlayacac, in the State of Morelos, Mexico. By Prof. A. Capen Gill, Ithaca, N. Y.*

13. *Syenite-Gneiss (Leopard Rock) from the Apatite Region of Ottawa County, Canada. By C. H. Gordon, Beloit, Wisconsin.*

The rock here described appeared in the exhibit of the Canadian Geological Survey, at the World's Fair under the title of "Concretionary Veinstone," from the apatite region. It consists of irregular ellipsoidal or ovoid masses of feldspar, with more or less quartz, separated by narrow, anastomosing bands of interstitial material consisting chiefly of green pyroxene. The ellipsoidal masses are of all sizes up to two or three inches in cross section, and several inches long. The field study at High Rock Mine, Ottawa County, shows this rock to occur in dikes intersecting the pyroxenites and quartzites. In some places the rock is very coarse with no indications of the ellipsoidal structure, while in others it is a distinctly banded gneiss whose identity with the ellipsoidal rock is evident from the anastomosing of the augite bands on a cross fracture face. Ordinarily the rock has very little quartz and corresponds to a pyroxene-syenite, but in some places the quartz is much more abundant thus allying it to the pyroxene-granites. In view of its gneissic structure and usually sparing amount of quartz the rock is here referred to generally as syenite-gneiss, though grading locally into forms which may more fittingly be regarded as granite-gneiss.

The presence of a distinct gneissic microstructure, taken in connection with other facts appears to establish the conclusion that the peculiar ellipsoidal structure is due to orographic forces acting upon a coarsely crystallized rock in which principal constituents (feldspar and pyroxene) are more or less irregularly distributed. The breaking of the rock under pressure has been attended by the recrystallization of the

augite and other constituents along the original fracture planes, which were probably, in part, determined by the arrangement of the two chief constituents.

The points of interest brought out in the study are: (1) that this peculiar distribution of the pyroxene is due to dynamic processes, (2) the importance to be attached to the process of solution and recrystallization in the formation of gneisses, (3) the significance of the original character of the rock with reference to the product derived from it by dynamic processes, and the differences resulting from variations in the extent to which it has been affected by orographic agencies, and (4) the evidence showing the derivation of a gneiss out of a syenite, and establishing the term syenite-gneiss as the name of a distinct rock type.

14. The Titaniferous Iron Ores of the Adirondacks. Prof. J. Kemp, New York City.

The paper opens with a brief statement of the characters of the two kinds of iron ores which are afforded by the region, the merchantable magnetites and the titaniferous. The former are in gneisses; the latter in the gabbros and anorthosites of the Norian, which are believed to be intruded through the gneisses. A list of localities of the titaniferous ores is given and distinction is made between the smaller bodies which are, so far as can be seen, basic developments of gabbro, and the enormous ore bodies at the old Adirondack Iron works, in the heart of the mountains. These latter are in massive, anorthosite, which is almost entirely formed of large, blue-black crystals of labradorite. The largest ore body, which is the one crossing Lake Sandford, contains numerous included labradorite crystals, each of which is surrounded by a reaction rim 5-10 mm. across. It is further shown that the wall rocks show no signs of the widespread crushing that is exhibited in the general "mortar-structure" of the Adirondack and Canadian anorthosites but are plutonic rocks, free from evidences of dynamic metamorphism. The argument is then made that the ores are segregations from an igneous magma formed during the process of cooling and crystallization.

15. The Decomposition of Rocks in Brazil. By J. C. Branner, Stanford University, Calif.

16. The Bearing of Physiography on Uniformitarianism. By Prof. W. M. Davis, Cambridge, Mass.

The conditions and processes postulated in the physiographic study of land forms—Geomorphology of some authors—are among the cardinal principles of uniformitarianism. The success in the interpretation of nature by means of this kind of study confirms the correctness of its postulates, and thus brings to the support of uniformitarianism a large class of facts, whose bearing on this theory was not at all perceived when its early advocates announced it.

17. Analysis of Folds. By Prof. C. R. Van Hise, Madison, Wis.

As ordinarily treated folds are considered as simple flexures in two dimensions. As they occur in nature folds are compound flexures in two dimensions. The analysis of simple folds given by Margerie and Heim is summarized. For the sake of simplicity folds are first treated in two dimensions. A composite fold is produced by the combination of various simple folds. Composite folds include both normal composite folds and abnormal composite folds. The genesis of each is discussed, and each is classified into upright, inclined, and overturned anticlinoria and synclinoria.

When composite folds are cross folded, these are called complex folds. The character and origin of complex folds are discussed. Rules are given for observation in regions which are folded in a complex manner. The use of folds in the discovery of unconformity and the secondary changes which accompany folding are summarized.

NOTES, REVIEWS, AND COMMENTS.

Entomology. —*FRAIL CHILDREN OF THE AIR. Another of Mr. Scudder's delightful books has just come to hand, with the above pretty title. It is a tastefully bound 8vo. of 279 pages, containing 31 short chapters, 9 plates, on the habits and structure of butterflies, written in a graceful, but clear and popular, style, which will make the book entertaining to many who have never taken any special interest in butterflies and will, we believe, realise the author's hope, expressed in the preface, "gain for our butterflies a deeper interest and closer attention on the part of the observing public.". This is really an excellent selection from a series of papers which ran through Mr. Scudder's large and costly work, "The Butterflies of the Eastern United States and Canada," and, although forming a "consistent whole," each chapter is complete in itself. The following titles of some of the subjects treated will give a slight idea of the scope of this attractive little volume: —Butterflies in Disguise, Butterflies as Botanists, Butterfly Sounds, The Eggs of Butterflies, How Butterflies pass the Winter, Protective Colouring in Caterpillars, The Procession of the Seasons, Some Singular Things About Caterpillars, The Friends and Associates of Caterpillars, Butterflies of the Past.

J. FLETCHER.

Geology.—RECENT PUBLICATIONS:—

1. CLAYPOLE, PROF. E. W.—"*Glacial Notes from the Planet Mars.*" American Geologist, Vol. XVI, No. 2 pp. 91—100, August, 1895.
2. UPHAM, WARREN.—"*Correlations of Stages of the Ice-Age in North America and Europe.*" *Ibid*, pp. 100—113.
3. JAMESON, CHARLES D.—"**Portland Cement**," "*a monograph.*" The Transit: Vol. III; No. 1, 192 pp. Iowa City, 1895.
4. RANSOME, PROF. F. LESLIE.—"*On Lawsonite, a New Rock-forming Mineral from the Tiburon Peninsula, Marin Co., California*" Bull. Dept. Geol. Univ. Calif.; Vol I, No. 10, pp 301—312, pl. 17; Berkeley, May, 1895,

Lawsonite is named in honor of Prof. A. C. Lawson, M.A., Ph D., etc., etc., Professor of Geology in the University of California, and formerly on the staff of the Geological Survey of Canada.

*Frail Children of the Air—Excursions into the World of Butterflies—By Samuel H. Scudder, Cambridge. Mass. $1,50.

5. VOGDES, A. W.—"*A Supplement to the Bibliography of the Paleozoic Crustacea.*" Extr. Proc. Cal. Acad. Sc., Ser. 2, Vol. V., pp. 53—76.

6. MATTHEW, Dr. G. F.—*On the Organic Remains of the Little River Group*, Nos. II and III. Trans. Roy. Soc. Can. Section IV, pp. 89—111, plate 1, figs. 1 to 11. Eight new species and one new genus are herein described for the first time from the "Devonian" of New Brunswick, as follows:

INSECTA:

1. Homothetus erutus, n.sp.

MYRIAPODA:

2. Palæocampa (?) obscura, n.sp.
3. Euphoberia atava, n.sp.
4. Eilaticus (?) antiquus, n.sp.
5. Hyodes (?) attenuata, n.sp.
6. Chilopus dubius, n.g. et. sp.

ARACHNOIDEA:

7. Palæophonus arctus, n.sp.

PULMONIFERA:

8. Pupa primæva, n.sp.

Besides the above Dr. Matthew also figures: *Eoscorpius carbonarius*, Meek and Worthen, from the Carboniferous of Illinois: *Palæophonus nuncius*, Thorell and Lindstrom, from the "Silurian" of Sweden, and a species of *Euphoberia*, from Plant Bed No. 2. The whole is a most valuable contribution to science. H. M. AMI.

7. WINCHELL, PROF. N. H.—"*A Rational View of the Keweenawan.*" Amer. Geol., Vol. XVI, No. 3, pp. 150—162, Sept, 1895. This forms the *seventh* article of a series on "Crucial points in the Geology of the Lake Superior Region" by Prof. Winchell.

8. BEECHER, DR. CHARLES E.—"*The Larval Stages of Trilobites.*" *Ibid.*, pp. 166 to 197, Plates VIII—X.

In this important contribution to our knowledge of the trilobites in their earliest stages, Dr. Beecher shows that "all the facts in the ontogeny of trilobites point to one type of larval structure." To the earliest larval stage, the name "*protaspis stage*," is given. Then follows a review of larval stages of trilobites, derived from such forms as *Solenopleura robbi*, Hartt: *Liostracus ouangondianus*, Hartt: *Ptychoparia lunnarssoni*, Walcott; *Ptychoparia kingi*, Meek; *Sao hirsuta*, Barrande: *Triarthrus becki*, Green; *Acidaspis tuberculata*, Conrad; *Arges consanguineus*, Clarke: *Proetus parviusculus*, Hall: *Dalmanites socialis*, Barrande.

Conchology. — A large land shell, new to the Ottawa list, was found at Casselman on May 23rd. It is *Helix palliata*. Three specimens were found, one west of the South Nation river, and two on the east side, below the falls, in the woods where the beautiful *Phlox divaricata* was then in full bloom. *H. palliata* is about three quarters of an inch in diameter, and differs from *H. dentifera*, which it most resembles in general appearance, in having the upper lip prolonged inward at two points into what are commonly called "teeth". A similar process is formed upon the body whorl These projections permit the soft tissues of the builder to pass, but oppose a pearly barrier to beetles and other enemies who would intrude upon the dweller within. The three teeth on the shell of *H. palliata* and other American land shells have been considered a peculiarity sufficiently distinctive to warrant the grouping of such species in a sub-genus, under the name *Triodopsis*. The study of the inhabitants of the shells grouped under this term has shown that many are less closely allied to other *triodopses* than they are to the *mesodons*, or shells of which *H. albolabris* and *H. thyroides*, also found at Casselman, may be regarded as the types. The shell alone can, in fact, be seldom relied on in arranging a natural classification of molluscs.

CASSELMAN SHELLS — A mere list of names is dry reading at best, and is of little interest to the general reader. In years to come, however, THE NATURALIST will be referred to, to ascertain what plants or shells at a particular time occurred in certain places. Any record, therefore, is likely to be of some use. At Casselman on May 23rd and 24th, a number of shells were noticed. No great effort was made to collect anything but what came in the way of a few members of the Club, while on a botanical excursion. This may account for the absence from the following list of such shells as *H. dentifera* and *H. thyroides*, which are known to occur at Casselman. The species noted were :— *Helix albolabris*, *H. sayi*, *H. palliata*, *H. alternata*, *H. concava*, *H. monodon*, *H. nitida*, *H. arborea*, *H. radiatula*, *H. fulva*, *H. striatella*, *H. pulchella*, *H. binneyana*, *Succinea ovalis*, *S. obliqua*, *Vitrina limpida*, *Limax campestris*, *Teb. Carolinensis*, *Vertigo ovata*, *Fer. subclinarica*, *Carychium exiguum*, *Gon. livescens*, *Camp. decisum*, *Limnæa palustris*, *L. caperata*, *Physa heterostropha*, *P. billingsii*, *Planorbis trivolvis*, *Pl. bicarinatus*, *Pl. parvus*, *Ancylus parallelus*, *Unio complanatus*, *U. luteolus*, *Anodanta fluviatilis*, *Sphaerium sulcatum*, *S. occidentale*, *Pisidium abditum*. L.

THE OTTAWA NATURALIST.

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HOW ROCKS ARE FORMED.

By R. W. ELLS, LL.D, F.R.S.C. of the Geological Survey of Canada.

Before taking up the general subject of rock formation, which in the limited time at my disposal, can only be touched upon in the briefest possible manner, we may for a moment glance, first of all, at some of the theories which have been put forth to account for the formation of the earth itself, in order that we may obtain a good starting point or acquire some idea of the conditions under which the foundations of the earth's crust were laid down, upon which the many thousands of feet of rock material which are known by the names of sandstone, slates, shales and limestones have been deposited.

Many theories have been put forth to explain the formation of the earth and to account for the many changes which transpired thereon before it became fitted for the advent of animal and plant life. Of these some are of interest from their legendary character, while others, regarded from the standpoint of modern science, present many features not reconcilable with the knowledge of the present day, and are of value, chiefly as illustrating the crude ideas that prevailed on this subject, prior to the advent of the present century. But few of the propounders of these theories made any attempt to approach so complicated a problem from a purely scientific standpoint. It must be borne in mind that the scientific study of the earth's crust is a matter of comparatively recent date, and our present knowledge is the result of very careful study, both in the field upon the rock masses themselves and in the laboratory, in which the science of chemistry and the microscope have played very important parts.

According to the theory now most generally accepted regarding the formation of the crust of the earth, viz., that of Laplace, there un-

doubtedly was a period in its history when rock structure, as we now know it, did not exist. This theory, which is commonly styled "the nebular hypothesis," most completely satisfies all the conditions required and may be briefly stated thus. It supposes that in the beginning the universe existed simply in a state of cosmic ether; that this in process of time gave off immense masses to which a rotary motion was imparted through various forces; that from these whirling masses large rings were separated, which by rupture and gradual condensation gradually assumed a spherical shape, as a consequence of the rotary movement, till at length the solar system, with its central sun and accompanying planetary bodies was evolved.

The cosmic matter, in process of time cooled down sufficiently to produce a crust, composed of various mineral constituents; and the cooling and hardening of the earth's mass proceeded either from the centre as a nucleus outward or by a gradual thickening of a first formed crust inward. Several theories have been proposed to explain this stage of the earth's history, but the greater number of physicists and geologists at the present day regard the globe as a more or less solid mass with areas of liquid matter at various points throughout the interior. Be that as it may we can safely say that the first rock material was produced by the gradual decrease in temperature of the original nebular mass, and in this way a foundation was laid down for the subsequent deposition of rock material, for the introduction of living organisms, and finally for the advent of man himself.

From a careful examination of many portions of this crust which have been brought to the surface either by denudation of overlying formations or by the extrusion of liquid matter, as in the case of volcanoes, it has been ascertained to be composed of a number of simple or undecomposable substances or elements of which about seventy have now been recognized. Of these the greater part apparently exist in very limited quantity, while the main mass of the crust is made up of a few easily recognized compounds formed from the union of two or more simple elements. The most abundant of these is silica which is the result of a chemical union of silicon and oxygen, and this constitutes more than half the mass of the earth's

crust. The other principal elements which enter into its composition are carbon, sulphur, hydrogen, chlorine, phosphorus and fluorine. All these are styled metalloids while among the metals are aluminum, calcium, magnesium, potassium, sodium, iron, manganese and barium.

Having thus secured a solid rock floor, of which we have most excellent illustrations in the range of Laurentian hills to the north of the river Ottawa, great portions of which presumably represent some of our first formed rock, the next development presumably was the precipitation of water, through the chemical union of the oxygen and hydrogen which entered largely into the composition of the gaseous envelope surrounding the newly created earth. From the geologist's standpoint, this may almost be regarded as our next rock formation: for throughout the whole subsequent history of the earth's devlopment, down to the present day, water has played a very important part. Gradually the watery envelope increased till, possibly, it swept resistless around the entire globe. By degrees, through the cooling and shrinking of the crust, ridges would be produced which formed barriers against which the mighty waves beat with the terrible force of the primeval ocean surge, tearing down and grinding to powder the newly formed coast line, and in this way the conditions were furnished by which the great thickness of the sedimentary formations which form so instructive a field of study to the working geologist, was laid down.

Taking this then as our starting point in geological time we may say that the greater part of the subsequent formations, as we now know them, was produced through the agency of fire or water. By the first we mean that certain portions of the earth's crust have been brought to the surface by means of volcanoes or great fissures in its surface, through which the liquified interior rock issued. These rocks are therefore known as igneous or volcanic, and are styled intrusive when the liquid has solidified before reaching the surface as in the case of granites, syenites &c., or eruptive when the intrusive matter has cooled or hardened after reaching the surface. Among these latter are the diorites, traps and volcanic ejectamenta generally. There is however a manifest difference in the character and composition of these two groups, the latter being ofen darker hued and finer grained, the

difference in texture being probably due to more rapid crystallization or cooling just as in the case of solutions of salt, sugar, alum &c., where we find that the slower the cooling the larger the grain of the crystal. These rocks, since they penetrated the oldest of the sedimentary formations, by which term we mean those which have been laid down by the action of water in some form may be regarded, as representing in some cases at least, certain portions of the original mass or crust of the earth.

The sedimentary or aqueous rocks are composed largely of grains of sand or often of pebbles, cemented together by sandy or calcareous particles. These grains of sand and pebbles have been derived from pre-existing rocks which in the first place presumably formed the first floor, and which have been broken down and reduced by the action of the elements, such as the force of waves, the rush of streams, the infiltration of rains or the action of frost. In addition to the beds of sandstone and conglomerate, others, composed largely of calcareous matter, in which the presence of organisms, as shells, plants, etc., can be recognized ; as can be seen in the many quarries in the vicinity of this city, where they extend over large areas, while yet others, composed of fine material, such as mud and silt, now occur as shales, and are easily recognized in the dark brownish or greyish material which is dug up in many of our streets or seen along the banks of the Rideau and Ottawa Rivers.

The manner in which many of these sedimentary rocks have been produced can be readily seen by any one who has ever studied, in the slightest degree, the action of water upon our sea coasts, lake shores, or along our river courses. Thus it will be observed that a coast line is generally composed of masses of rock jutting out here and there in the form of cliffs or projecting points. These are separated by stretches of beach or low shore in which rock ledges are frequently absent, but which are composed of sand, gravel, mud, clay or boulders. These have been produced by the long continued action of wave or current against the rocky barriers, the force of which, by mechanical impact, tends to break down the mass of the cliff into scattered blocks and distribute them about its base. Subsequent rolling and dashing

against each other gradually reduce these to a state of sand or clay, and in this way are produced the materials which make up the sandstones and conglomerates. These, by the various changes which are taking place in the earth's surface, become buried under other deposits and are acted upon by the agencies of heat, pressure and other causes till they become firm and enter into the solid constituents of the earth's crust. The softer muds and silts of the beach also undergo a change and pass into shales. This material is deposited under quieter conditions, in sheltered bays or creeks, where the finer earth particles held in water, are gradually deposited. Shales pass into slates through the formation of cleavage planes which have been induced by pressure in the shaly mass, and by hardening through metamorphic agencies. Wherever organic life has existed on the beach or shore, these remains gradually become entombed and we now find the impression of the long extinct bird, fish, plant or insect, often so perfectly preserved that the most delicate points of structure can be readily determined. These organic remains are found to vary in character at different horizons, so that what are found in one rock series often do not appear in others more recent; and upon this peculiarity of distribution, palæontologists and geologists have built up a scheme of rock formations, which comprises all the sediments from the Laurentian time or the original deposition of the earth's crust, down to the present day, each division of which is distinguished by certain fossil forms peculiar in large part to itself. In this way we can depict the whole life history of the globe, from the advent of the first forms, through plant, fish, bird, reptile, etc., to the mammalia, and up to the highest type of all the genus *Homo*, or man himself.

While, however, sedimentary rocks are deposited as sands, clays or calcareous matter in generally horizontal attitudes, such as we see in the strata surrounding this city, very frequently these strata are tilted at all angles, and in some cases completely overturned. This change in position is accompanied often by a change in the character of the original sediments, and is due to some agency, either of contraction or shrinking of the crust or to dislocations which have produced crumplings, upheavals, displacements, etc. In this way sandstones have been

frequently changed to hard quartzites, shales to cleaved slates, and limestones to a crystalline condition, as marbles. Often all the alteration is directly due to the presence of heated masses of intrusive rock, as granite, syenite or diorite, which have ascended from the heated interior along lines of fracture or least resistance, and the heat has deprived the rock in contact of much of the contained moisture, changing the texture and altering its character for a considerable distance from the line of contact of the intrusive mass.

As regards some of the more important minerals found in the stratified rock, their formation has proceeded on somewhat similar lines. Thus if we study the early history of the coal beds, some of which have a thickness of from thirty to forty feet, we find that they have originated probably from swampy deposits somewhat of the nature of our present peat mosses, and that the growth and decay of vegetable matter went on for very long periods. On the basis of eight to ten feet of peat or swamp mud being required for every foot of coal produced, a thirty foot coal seam would have required a swamp of enormous depth to have furnished the material necessary for the formation of such a coal bed. That the coaly matter has been derived from the decomposition of plants, such as tree ferns and other allied forms, which grew in the marshes of the Carboniferous time is very clear, since the remains of the coal-plants can be found well preserved in the shales which overlie the coals and in the clays which form their underlying strata, as well as in the tissue of the coal itself. It would appear that the woody or interior tissue gradually became destroyed, while the carbon of the bark principally formed the mass of the coal itself. These masses of swamp or peaty matter, gradually by submergence become overspread with sand, gravel or silt, which by continued increase in thickness acquired sufficient weight to press down the mass of bog, until by long continued pressure and other causes it became transformed into the coal which we mine and burn to-day.

Somewhat similar changes and conditions are going on at many places at the present time in our own peat deposits. Thus at the great bog near the city known as the "Mer Bleu" which is a great expanse of peat of from 8—10,000 acres in extent, the surface is covered with

green moss, ferns, shrubs and stunted trees, the whole forming a light colored layer of two or three feet in thickness. Beneath this the contents of the bog gradually become dense and darker colored; the green living vegetation has disappeared, but its remains yet exist in the form of rootlets, stems &c. Still lower down the bog presents a still more homogenous aspect, the vegetable matter is almost entirely decomposed, and the mass is of a uniform dark brown or black color and of a very considerable density, forming a very excellent fuel when dug out and dried. Where this material is subjected to great pressure it furnishes a material known as compressed peat which can be so manufactured as to have all the density and calorific power of coal itself, and thus is able to furnish a material of very great value for all the purposes for which ordinary coal is now applied. There is therefore a manifest resemblance between these modern bogs and those from which our beds of mineral fuel were derived; with this exception, that the character of the growing vegetation, and the nature of the animal life which inhabited these were widely different; while the presumption is strong that if these peat bogs could be subjected to the same conditions which affected those of the Carboniferous time, the resulting material would be a coal of somewhat similar character. Coals of an intermediate character are also found as in the great lignite deposits of the Saskatchewan and Souris areas, where the mineral still retains to a marked extent its original woody fibre. On the other hand when the bituminous coals have been subjected to the action of further heat and pressure, the result appears in the form of anthracite or hard coal, in which much of the volatile matter has been driven off. A still further alteration results in the formation of graphite. Beautiful illustrations of this latter condition are found in some deposits in southern New Brunswick, where the coal is graphitized anthracite, the containing rocks being thrown on edge and much altered.

Other kinds of rock masses may be mentioned, such as rock-salt, gypsum, shell-marl, infusorial earth, chalk, iron ores of various kinds, petroleum and petroleum-bearing shales. Of these, rock-salt has probably been formed by the evaporation of saline waters in enclosed basins, a process which has been going forward at many stages of the

world's history, and is seen at the present day in nature in the Great Salt Lake of Utah, as well as at all points where salt is produced by solar evaporation or action. Gypsum is formed principally as a chemical precipitate from solution in water, as well as by the action of sulphurous vapours from volcanic vents upon calcareous rocks. Shell marls are mostly of organic origin, formed by the accumulation of the remains of shells in the bottoms of lakes or ponds, often seen underlying peat bogs, as is also the case with certain of the limestones where the mass of the rock is made up almost entirely of organisms. Certain of the limestones, however, are formed by chemical action, by deposition of calcareous matter in solution, in which case they are frequently highly siliceous and devoid of all trace of organic life. Chalk is formed like shell marl, only differing in its being of marine instead of fresh water origin; the mass of the deposit being principally calcareous, while with infusorial earth which is formed from portions of diatoms, the mass is chiefly siliceous. This substance although requiring a high power of the microscope to detect the traces of the organisms is often found in deposits of many feet in thickness.

The deposits of iron ore, which form a very important portion of the economic products of the earth's crust, owe their origin very largely to the action of certain organic acids, which have been produced by the decomposition of vegetable matter upon the ferruginous minerals found in many rock masses, and which thus pass into solution with water. These solutions rapidly decompose under certain conditions and the iron salts are precipitated, and become mixed with sands and clays, gradually forming beds of what is known as bog iron ore. This material in certain areas constitutes deposits of very great extent as in the St. Maurice district, where these ores have been mined and smelted for over 150 years, and are still as abundant as ever, at many points. The other ores of iron, such as limonite, hematite, magnetite &c., which frequently occur in immense masses have also been regarded by some chemists, and geologists as owing their existence to organic agencies, and their present condition is supposed to be due to the great metamorphoses to which they have been subjected during the great lapse of time since their deposition. It seems however probable from the

associations of many of these deposits with clearly intrusive rocks that their origin is more closely related to these latter than to any organic agencies as is the case with the recent iron ore deposits.

Of late years the microscope has come to the aid of the field geologist and has been of wonderful assistance in solving the problem pertaining to the structure and origin of many rocks, concerning whose genesis much doubt had long existed. By the increased light thus furnished, many new facts have been adduced which have, on certain lines, almost entirely revolutionized our earlier ideas as to rock structure and by the union of the forces of the field and the laboratory much more satisfactory conclusions have been reached, It may be safely said that by this means, the progress in accurate geological investigations during the last ten years has been far greater than in any previous similar period, and the results obtained have been much more reliable.

The vicinity of Ottawa is excellently adopted for the study of many rock formations. Along the line of the Gatineau railway many beautiful sections of the early crust are exposed in the form of granite, gneiss and crystalline limestone, and their intersections by dyke-like masses of deeper seated rocks are well seen, as syenites, diorites, pyroxenes, felspars, etc. The Ottawa, Arnprior and Parry Sound and the Canada Atlantic Railways both traverse areas occupied by the lower Palæozoic rocks and many instructive outcrops of sandstone, shale and limestone are easily available to the geological student. Some of the strata of the Chazy and Trenton are wonderfully rich in organic remains. The former of these two great rock divisions illustrate the conditions which prevailed when the earliest ocean waves dashed against the oldest outlines of our continent, and strewed the debris of sand and pebbles throughout the Ottawa area, while the limestones and shales of the Chazy and Trenton show the prevalence of deeper water conditions and the abundance of the animal life even in those early days of the world's history. The most recent deposits of clays, sands and gravels can also be studied at many points along the river Ottawa as well as over the country adjacent on either side, and their contained organisms, in the shape of bones of seals and fishes, as well as marine shells, are familiar to many of the

members of our club. These shell deposits are found at many points along the hills around Ottawa and away up the river to the west at elevations of hundreds of feet above present sea level, and show that the deposits of these portions of the present crust of the earth were due to the series of rhythmic pulsations which seem to be constantly going on, and by which at one time, the surface is raised to a considerable elevation above tide water and then gradually becomes submerged till the ocean waves wash the sides of our highest hills.

It will be readily admitted by everyone conversant with the study of Geology, that, like all other branches of science, it is extremely progressive in its tendency; but though the new facts acquired year by year, through our recent sources of knowledge, have led to many changes of view as to the origin, history and manner of formations of the component parts of the earth's crust, it should not be assumed that as a consequence any discredit should attach to the conscientious work of the pioneers in the science, but rather the greater credit should in many cases be given, in that they, with such poor materials at their disposal and such a lack of facilities at their command for investigation, should have been able to accomplish so much, and to obtain results so generally satisfactory to those who have since studied the rocks in the light of modern science.

REPORT OF THE GEOLOGICAL BRANCH, 1894-95.

(Read December 20th, 1894.)

To the Council of the Ottawa Field-Naturalists' Club :

The following notes on geological work carried on in this vicinity by members of the Club and others indicate clearly the interest which still prevails in the study of the geological formations about Ottawa.

Considerable geological work was done at the three general excursions held under the auspices of the Club

The following table shows the various places visited and the geological formations noticed and reported upon either orally at the excursions by the leaders, or in the NATURALIST* :—

EXCURSION			
No. 1. CHELSEA.	Saxicava sand, Leda clay.	Fossils abundant.	Sands and gravels, clay, &c.
	Boulder clay.		
	Archæan.		Gneisses, limestone, ophite, diorite, &c.
No. 2. WAKEFIELD.	Leda clay. Boulder clay.	No fossils collected	Marine clay and boulder clays, glaciated rocks.
	Archæan.		Gneisses, pegmatites, &c.
No. 3. GALETTA.	Pleistocene.	Marine Fossils in the gravel pit at Carp Station.	Chrondrodite limestone, syenite, &c., overlain by marine clays and sands.
	Archæan, &c.		

Besides the three general excursions, above mentioned, there were held a number of sub-excursions in which various members of the Club and others interested took part.

These are some of the localities visited :—

1. PORTER'S ISLAND, RIDEAU RIVER, OTTAWA In April, 1894,

*(a) Vol. VIII., No. 3, pp. 42-43, 1894.
(b) Vol. VIII., No. 5, pp. 74-75, 1894.
(c) Vol. VIII., No. 7. pp. 109-110, 1894.

the writer, together with Mr. B. E. Walker, F.G.S., of Toronto, Mr. N. J. Giroux, C.E., Mr. J. C. Reichenbach, and others visited this island, where extensive excavations made by the civic authorities had brought to view the fossiliferous strata of the middle Utica. Large blocks of black bituminous shale were examined and a perfect harvest of interesting forms obtained.

Slabs covered with the remains of graptolites of the genus *Leptograptus*, beautifully preserved and showing the hydrothecæ and other points of structure wonderfully well; colonies of the sponges recently described for the writer by Dr. Hinde as *Stephanella sancta*, together with remarkably well-preserved specimens of *Triarthrus spinosus* were found in tolerable abundance.

A complete list of the species collected on Porter's Island will be published in a future number of the NATURALIST, if desired.

2. HULL, Que. The quarries at Hull both north and south of the C. P. R. track, were again visited and as usual yielded a number of interesting forms, especially crinoids.

On one occasion, in two hour's search the writer and two friends secured no less than 30 heads of crinoids besides a large number of beautiful examples of *Trematis Ottawaensis*, Billings and an undescribed bryozoary.

3. BESSERERS, *Ottawa River.*—9 miles below Ottawa City. In company with Mr. Lambe of the Geological Survey the writer spent a day collecting in the Post Pliocene marine clays of this locality during low water in September. Besides some *fifty* specimens of fossil fishes —*Mallotus villosus*, Cuvier, collected on this occasion—there were obtained remains of shells and plants in tolerable abundance. Some fifty specimens of plants were sent to Sir William Dawson and include remains of algæ or seaweeds, mosses, equisetaceæ, fruits, grasses, sedges and leaves of trees and flowering plants.

Two fossil feathers were also collected. The first specimen of a fossil feather from those marine clays discovered as far as we know was that obtained by the Marquis of Lorne at Green's Creek, during his

term of office, about 1881, and is now on exhibition in the Pleistocene case at the Geological Museum on Sussex street.

Several papers bearing on the Geology of this district have appeared from time to time in the NATURALIST during the past year.

The Director of the Geological Survey of Canada (Dr. Selwyn) has undertaken to publish a series of Geological maps of this portion of Canada and entrusted this work to Dr. Ells who is also one of the leaders in Geology of our club. I have no doubt that he will find useful and interesting material in the published records of the geology of Ottawa or in the unpublished notes of the leaders in geology.

Records and notes have been kept during the past fifteen years at least, an amount of useful information which will be useful in preparing a more detailed and accurate geological map than has heretofore been published. Early in the spring of '94, one of your leaders, the writer, issued a chart of the Geological formations of Ottawa and its environs extracted from a paper published in 1888 on the formations of this district.

What is now required is a good topographical map of this district upon which to lay the geological features. Considerable difficulty has been met in the fact that the surveys on the Ontario side do not correspond with those on the Quebec side of the Ottawa and require to be corrected at numerous points. Considerable progress however was made in this direction by the late Mr. Scott Barlow, Chief Draughtsman of the Survey, and this branch of the Club's work looks forward to the time when such a map will be prepared for the Ottawa district.

In the meantime a great deal remains to be done in geology about Ottawa. The structure and composition of the older crystalline rocks at our very door, their origin and age are only begining to be studied and understood, whilst the fossiliferous rocks always prove to the diligent searcher that many forms new to science are still awaiting to be discovered.

In conclusion we trust that good results will long continue to be forthcoming in this branch of the Club's work.

(On behalf of the leaders) H. M. AMI.

NOTES, REVIEWS, AND COMMENTS.

Glacial Deposits in Europe and America.—In the April-May issue of the *Journal of Geology*, Vol. III, No. 3. pp. 241-269, James Geikie contributes a valuable paper entitled :— "The Classification of European glacial deposits."

It is a clear and conscise résumé of the evidence gathered by one whose intimate acquaintance with the facts of the case enable him to present the various stages which characterized glacial times in Europe. From the earliest glacial deposits of northern Europe—the Scanian—to the latest, the Upper Turbarian or sixth glacial period, Dr. Geikie notes **five interglacial periods** and **six** glacial periods, which he designates as follows :—

EUROPEAN GLACIAL AND INTERGLACIAL STAGES.

XI. Upper Turbarian—Sixth Glacial Period.
X. Upper Forestian—Fifth Interglacial period.
IX. Lower Turbarian—Fifth Glacial Epoch
VIII. Lower Forestian—Fourth Interglacial Epoch.
VII. Mecklenburgian—Fourth Glacial Epoch.
VI. Neudeckian—Third Inter Glacial Epoch.
V. Polandian—Third Glacial Epoch.
IV. Helvetian—Second Interglacial Epoch.
III. Saxonian—Second Glacial Epoch.
II. Norfolkian—First Interglacial Epoch.
I. Scanian—First Glacial Epoch.

This admirable paper by Dr. Geikie is followed by another on "The classification of America's glacial deposits" 270—277, (*loc-cit.*) by Prof T. C. Chamberlin in which the latter points out the relations which exist between the stages mentioned by Dr. Geikie in his paper on European glacial deposits and the stages in America. Prof. Chamberlin remarks: "Our knowledge of the formations that were deposited during the advancing stages of the glacial period in America is extremely imperfect." This strikes the key-note to a series of careful investigations which ought to be made in the lowest glacial deposits of North America and specially in British North America such as will enable the correlations of the different stage in Europe and America to be more accurately established. Prof. Chamberlin attempts to correlate the *Kansan formation* with the *Saxonian* of Europe owing to their striking

similarity, in that they "alike repre sentthe greatest extension of the ice-sheet. The *Aftonian* and the *Helvetian* are then compared indicating a retreat of the ice-sheet.

Then the *Iowan* formation of Dr. McGee — which Chamberlin co-relates with the *Polandian* with some doubt.

The *Toronto* formation correlated with the *Neudeckian* (?); the *Wisconsin* formation with the *Mecklenburgian* (?) and the later deposits are compared with the *Forestian* and *Turbarian* deposits of Europe.

These two papers are most interesting contributions to glaciology.

H. M. AMI.

Botany.—RARE MANITOBAN PLANTS.— I beg to note the finding of the following plants at Stony Mountain, Man., on August 12th 1895.

(1) *Gerardia tenuifolia*, Vahl. var. *asperula*, Gray.

This was recorded from the same locality by J. M. Macoun. Many years ago I noticed it northwestward towards Lake Manitoba. This would seem to confirm the conjecture made in Prof. Macoun's Catalogue that G. aspera of Douglas, should be referred here.

(2) *Bouteloua racemosa*. Lag. This grass is very rare in Canada, it was found in the same locality by Mr. Fletcher in 1883.

(3) *Pellœa atropurpurea*, Link. On limestone rocks. This is the first record for Manitoba, though there are several for the North West Territories.—Rev. W. A. BURMAN, *Winnipeg, Man.*

ASPLENIUM RUTA-MURARIA, L:—In the OTTAWA NATURALIST for November 1892, Dr. T. J. W. Burgess, F. R. S. C., records the first discovery in Canada of this rare fern by Dr. P. J. Scott, of Southampton, Ont., on Flower-pot Island, near Tobermorey, Bruce Co. Ont.

In looking through some botanical specimens collected by the Rev. W. A. Burman, of Winnipeg, at Banff, Rocky Mountains, in June 1894, I find some good fruiting fronds of this fern. This is the second locality in Canada so far recorded.—J. F.

Zoology.—THE COMMON HOUSE MOUSE, *Mus musculus*, L. Two specimens of a mouse taken by the Rev. J. H. Keen, at Fort Simpson, Northern British Columbia, were forwarded for identification to Mr. S. N. Rhoads, of the Academy of Natural Sciences of Philadelphia Pa., who reports that they are the above species, and, that the capture so far north is of interest.—J. F.

Entomology.—PAMPHILA PECKIUS, Kirby.—This pretty and common little Skipper, of which there is normally but one brood in the year at Ottawa, the butterflies appearing in the latter half of June, has this year been practically double-brooded. During the hot weather we had last September numerous specimens were seen darting about the beds of *Phlox Drummondii* at the Experimental Farm. In previous years an occasional specimen has been recorded in the autumn but this year the species was abundant.—J. F.

SPHINX LUSCITIOSA, Cram. A fine male specimen of this rare Hawk Moth was taken by Mr. William Ellis in the Conservatory at the Experimental Farm on June 15th. It was flying by day-light and was watched for some time sipping the nectar from the flowers of some Cattleyas and other orchids. Many years ago a single specimen was taken at rest in New Edinburgh by Mr. Harrington and later Mr. F. W. Warwick of Buckingham, P. Q. took two females at Lilac flowers. An interesting record of this species is that of a specimen taken by Mr. A. W. Hanham at Winnipeg on 1st. July last. It was at rest beneath some loose bark on a fence post. It may be mentioned in case anyone should be fortunate enough to get the eggs at any future time that the food plant of the caterpillar is willow.—J. F.

PROGRAMME OF WINTER LECTURES IN OTTAWA.

Under the joint auspices of the Ottawa Literary and Scientific Society and the Ottawa Field-Naturalists' Club a special Soirée Committee Meeting was held in the Normal School on the afternoon of Wednesday, Oct. 30th, 1895, when the following programme of lectures, etc., for the ensuing season of 1895-1896 was decided upon :—

1895. PROGRAMME OF LECTURES, SOIRÉES, ETC. 1896.

1895.

NOV. 26th. Conversazione. On this occasion addresses will be given by Dr. MacCabe, F.R.S.C., Dr. R. W. Ells and Mr. F. T. Shutt, M.A., F.I.C. During the evening objects of special interest will be shown under microscopes and in cases prepared for the evening by various members of both societies. Music, vocal and instrumental, will also form a part of this opening entertainment.

DEC. 5th. 1. The value of Botany in Agriculture. By Prof. John Macoun, M.A., F.L.S.

2. A Naturalist in British Columbia. By Prof. James Fletcher, F.R.S.C., etc. Illustrated.

DEC. 12th. A Greek Tragedy. By Prof. MacNaughton, M.A., of Queen's University, Kingston.

1896.

JAN. 9th. Longfellow. By the Hon. Dr. Montague, M.P.

" 23rd. Extinct Monsters By Mr. H. M. Ami, M.A., F.G.S. Illustrated by lantern slides and views.

" 30th. Labrador. By Mr. A. P. Low, B.A.Sc. Illustrated by lime-light views.

FEB. 6th. How to Study Botany. By Dr. T. J. W. Burgess, of Montreal. Illustrated.

" 20th. Pompeii, a Roman City of the first century. By Prof. Frank D. Adams, M.A.Sc., Ph.D., of McGill College, Montreal. Illustrated by lime-light views.

MAR. 5th. 1. Eggs and Nests of Fishes. By Prof. E. E. Prince, B.A., F.L.S., Commissioner of Fisheries for Canada.

2. Bacteria, their functions in Nature. By Mr. F. T. Shutt, M.A., F.C.S. Both papers to be illustrated by specimens.

Lectures at 8. p.m. sharp, in the Lecture Hall of the Provincial Normal School, Cor. of Elgin and Lisgar Streets. **Admission Free.**

THE OTTAWA NATURALIST.

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THE LAND AND FRESHWATER SHELLS OF ALBERTA.

BY REV. GEO. W. TAYLOR, F. R. S. C. (Nanaimo, B. C.)

Very little has been published up to the present time on the Mollusca of the District of Alberta.

The first naturalist to pay any attention to the subject was, I believe, Dr. G. M. Dawson, who, 20 years ago (1873-74), was acting as naturalist to the British North American Boundary Commission, and who published (in 1875) as an appendix to his report, a list of the land and freshwater shells that he had obtained during the progress of the boundary expedition.

Though most of his shells were collected in the neighbourhood of the Lake of the Woods and in other places in Manitoba and Assiniboia, Dr. Dawson obtained a few species in Alberta, the most notable being a fine variety of *Patula strigosa* which was found near Waterton Lake at the base of the Rocky Mountains and just within the boundaries of the district. At the time this shell was thought to be an undescribed species and was named by Dr. Dawson *Helix limitaris*.

Since the date of Dr. Dawson's explorations Alberta has on several occasions been visited by members of the staff of the Geological Survey and I have seen in the Museum at Ottawa some interesting species collected by them; but as no record of these shells appears to have been published, and I am ignorant of the precise localities whence they came, I do not like to include them in the present list.

Three years ago Mr. T. E. Bean, the well known lepidopterist of Laggan (which place is close to the Western boundary of Alberta) began to investigate the shells of his neighbourhood and very kindly gave me specimens of all the species he observed. In the autumn of 1893 I had the pleasure of spending two days at Laggan in Mr. Bean's

company and was successful in finding several species that had escape his notice.

The result of our joint collections was published in the "Nautilus" for December 1893 (Vol. VII. p. 85.) Nineteen species (14 land and 5 freshwater) are enumerated in that paper and two other land shells should also have been included viz. *Pupa simplex* and *Vertigo ovata* of both of which species Mr. Bean had taken specimens.

During the past three summers (1892-3-4) Mr, A. O. Wheeler. D.L.S. (now of the Canadian Topographical Survey, Ottawa) has been surveying in different parts of the district. While in the field he has always, most kindly, kept a sharp lookout for shells, and at the close of each season has very liberally sent his collections to me. As a result chiefly of Mr. Wheeler's industry and success as a collector I am now able to present a list of 44 species of land and freshwater shells inhabiting this little known part of the Dominion.

The first of Mr. Wheeler's collections was made in the summer of 1892. Shells were obtained in the Battle River at a point where the Calgary and Edmonton trail touches the river, about 60 miles south of the last named town. From this locality came five (5) specimens of *Anodonta lacustris*, two of *Margaritana complanata*, one of *Unio luteolus* and two of the large heavy form which in Canada goes by the name of *Unio subovatus*; also, three valves of *Pisidium abditum* and a single valve of a *Sphaerium* which Mr. E. W. Roper has pronounced to be probably *S. fabale*.

A few shells were also collected in a creek and a slough both near Egg Lake, twelve miles south of Victoria (a Hudson Bay Post) on the Saskatchewan River. In the creek were obtained *Planorbis trivolvis* and *Limnæa stagnalis*; and in the dried up slough *Segmentina armigera* (one specimen,) *Limnæa palustris*, *Sphaerium solidulum* (four valves only) and twelve specimens of a *Succinea* which I think must be *S. Grosvenori*.

Mr. Wheeler's next collection was a much larger one made in 1893 while he was surveying 30 or 35 miles east of Red Deer on the Calgary and Edmonton Railway. Among the land shells, which were mostly collected in dried-up sloughs, were numerous specimens of

the widely distributed *Vitrina limpida*, *Hyalina arborea*, *Hyalina radiatula*, *Conulus fulvus*, *Patula striatella*, *Vallonia costata* (form *gracilicosta*) and *Ferussacia subcylindrica*. Besides these there are specimens of three species of *Pupa*, namely *P. armifera* (19 specimens,) *P. Blandi*,(4),and *P. Holzingeri*,(2) all collected from drift by the Red Deer River. Lastly, there were specimens of 3 species of *Succinea* which, throughout this paper I have called *S. avara*, *S. ovalis* and *S. Grosvenori*. I must say however that though using these names I am of opinion that the first two are applied to shells specifically distinct from the eastern shells that are so called.

Of freshwater shells Mr. Wheeler collected 13 species: the ubiquitous *Limnæa palustris* and *L. stagnalis*, *Planorbis trivolvis* and *Physa heterostropha*, *Bulimus hypnorum* and *Pisidium abditum*; also the less abundant *Limnæa desidiosa L. caperata* and *L. reflexa*, *Segmentina armigera*, *Valvata tricarinata* (Red Deer River) and lastly a number of specimens of *Planorbis nautileus var. cristatus*, which I begin to think must be indigenous to North America. These last named shells were found in moss from the bed of a muskeg in township 39, range 23, W. of 4th. meridian. Specimens of *L. reflexa* in this collection are the largest I have ever seen, attaining a length of 42 mm.

The latest of Mr. Wheeler's collections was received in January last and contains the shells collected by him during the summer of 1894 in Southern Alberta in the neighbourhood of MacLeod and the Little Bow River.

There are not so many species in this as in the former collections but among them are three notable additions to our list, *Planorbis umbilicatellus* (2 specimens), *Limnæa bulimoides* and *Sphærium Jayanum*. The first named appears to be quite distinct from *P. parvus* with which, judging merely from the original description and figure, I was formely inclined to unite it. This interesting shell was described as *Planorbis umbilicatus* by Mr. J. W. Taylor in the English "Quarterly Journal of Conchology" Vol. iv, p. 451 (July 1884), from specimens collected by Mr. R. M. Christy, near Brandon, Birtle and Rapid City in Manitoba. The name being pre-occupied it was changed to *umbilicatellus* by Mr. T. D. E. Cockerell in the "Conchologists' Exchange"

November 1887, p. 68. The species was not again noticed, I think, until Mr. Homer Squyer quite lately found a single specimen in river drift near Mingusville, Montana as recorded by him in the "Nautilus" for October 1894 (Vol. viii. p. 95.)

The second addition to our list from this collection is a small *Limnæa* which is probably the *Limnæa bulimoides* of Lea. Though allied to, and in this instance collected with, *Limnæa palustris* it seems quite distinct from all forms, that I have seen, of that very variable species. The largest of the 28 specimens collected is only 8 x 5 mm. but is quite mature and has a thickened red-edged outer lip and also a second red line, marking a former stage of growth, about 1½ mm. within the aperture.

The third addition is *Sphærium Jayanum* and the shells I refer to this species are from Crow Lodge Creek, Mosquito Creek and Little Bow River.

The other shells contained in this collection are *Conulus fulvus Patula striatella, Succinea avara, Pisidium abditum, Limnæa palustris, L. stagnalis, L. caperata, L. desidiosa, Planorbis trivolvis, P. parvus*; *Physa heterostropha* and *Bulimus hypnorum*, all common and widely distributed species.

It will be seen that Mr. Wheeler's collections have added twenty two species to the twenty one already known from Laggan and if we add also Dr. Dawson's *Patula strigosa* we shall have 44 as the grand total of the land and freshwater Mollusca of Alberta as at present known.

No doubt this list will some day be considerably extended and an examination of the list of Montana shells lately published in the "Nautilus" by Mr. Squyer and the other Manitoba and Assiniboia lists of Dr. Dawson, Dr. Bell, and Mr. R. Miller Christy, will give us a good idea of the species that may be expected to occur also in Alberta.

In the list that follows the three collections of Mr. Wheeler, the Laggan shells of Mr. Bean and myself, and a small collection received a few days ago from Mr. T. N. Willing of Olds, Alberta, through the kindness of Mr. James Fletcher, are tabulated, *Patula strigosa*, as

mentioned above, is added on the authority of Dr. Dawson although it has not occurred in any of the collections I have examined.

LIST OF THE LAND AND FRESHWATER SHELLS OF THE DISTRICT OF ALBERTA.

LAND SHELLS	Bean & Taylor	Wheeler, 1892	Wheeler, 1893	Wheeler, 1894	Willing, 1895	Remarks.
1 Limax hyperboreus, West.	x					
2 Vitrina limpida, Gould	x		x			
3 Hyalina arborea, Say sp	x		x		x	
4 Hyalina radiatula, Alder, sp.	x		x			
5 Conulus fulvus, Drap. sp	x		x	x		
6 Patula strigosa, Gould sp.						Waterton Lake
7 Patula striatella, Anthony sp.	x		x	x	x	
8 Vallonia pulchella, Mueller sp. *form* gracilicosta, Reinh	x		x			
9 Pupa Hoppii, Mueller.	x					
10 Pupa Blandi, Morse, .			x			
11 Pupa armifera, Say . . .			x			
12 Pupa Holzingeri, Sterk.			x			
13 Pupa pentodon, Say sp	x					
14 Pupa simplex, Gould	x					
15 Pupa alticola, Ingersoll	x					
16 Vertigo ovata, Say	x					
17 Vertigo ventricosa, Morse	x					
18 Ferussacia subcylindrica, Linn, sp	x		x			
19 Succinea avara, Say . . .	x		x	x	x	
20 Succinea ovalis, Gould	x		x			
21 Succinea Grosvenori, Lea.		x	x			
FRESHWATER SHELLS.						
22 Valvata sincera, Say . .	x					
23 Valvata tricarinata, Say			x			
24 Limnæa stagnalis, Linn, sp.		x	x	x		
25 Limnæa reflexa, Say .			x			
26 Limnæa palustris, Mueller, sp	x	x	x	x	x	
27 Limnæa bulimoides Lea				x	x	
28 Limnæa desidiosa, Say			x	x		
29 Limnæa caperata, Say			x	x		
30 Physa heterostropha Say.			x	x	x	

FRESHWATER SHELLS.	Bean & Taylor.	Wheeler, 1892.	Wheeler, 1893	Wheeler, 1894	Wheeler, 1895	Remarks.
31 Bulimus hypnorum, Linn, sp.			x	x	x	
32 Planorbis trivolvis, Say	x	x	x	x	x	
33 Planorbis parvus, Say	x		x	x	x	
34 Planorbis umbilicatellus, Cockerell.				x		
35 Planorbis nautileus, Linn, var cristatus			x			
36 Segmentina armigera, Say, sp.		x	x			
37 Sphærium solidulum, Prime		x				
38 Sphærium fabale, Prime		x				
39 Sphærium Jayanum, Prime				x	x	
40 Pisidium abditum, Haldeman	x	x	x	x	x	
41 Unio luteolus, Lam.		x				
42 Unio subovatus, Lea		x				
43 Magaritana complanata Barnes		x				
44 Anodonta lacustris, Lea		x				

REPORT OF THE ENTOMOLOGICAL BRANCH, 1894.

Read, February 12th, 1895.

To the Council of the Ottawa Field-Naturalists' Club:

It is with pleasure that the Leaders report to the Club the prosperous state of this branch. A great deal of good work has been done during the past year, not only in collecting specimens in the various orders of insects, but also in working up material accumulated in previous years. In this way many names have been added to the lists of insects recorded as having been found in the district. A few of the more interesting finds have been recorded in the *Ottawa Naturalist*, and the others have all been recorded for publication in the lists, from time to time, as these are thought sufficiently complete. During the year, two supplementary lists of local Hemiptera have been published by Mr. Harrington. In addition to the work done by the leaders individually, the opportunities of interesting members of the Club at the excursions were taken advantage of with the good result

that some good species were secured by members not specially interested in Entomology.

At the first excursion in the spring, we were pleased to welcome Dr. Scudder, of Cambridge, Mass., the eminent American entomologist, and also our fellow-member, Dr. Bethune, of Port Hope, the editor of the *Canadian Entomologist*, and well known for many years as an active Canadian naturalist. Dr. A. H. Mackay, and Prof. J. Fowler, of Kingston, experienced botanists, were also with us, and helped to make a most successful and enjoyable excursion, particularly for the entomologists and botanists.

Some of our members made interesting collections in the west; notably Prof. Macoun, at Crane Lake, and Messrs Klotz and Simpson, in Alaska.

LEPIDOPTERA

On the whole the past season cannot be said to have been a very good one for insects, although, as is always the case, careful search and constant watchfulness added several desirable species to our cabinets. Some good work has been done in working out the life histories of some of the native butterflies and moths, a most fascinating study, and an excellent means of securing good specimens for the cabinet. The following species have been partially or completely reared from the egg:—*Papilio Bairdii*, *(= Oregonia,) Colias Elis*, *Colias Nastes*, *Chionobas Jutta*, *C. Macounii*. The first from eggs sent from Colorado, by Mr. W.H.Edwards, and all but the last, from eggs collected at Laggan, in the Rocky Mountains by Mr. T. E. Bean. From eggs obtained at Ottawa : *Chrysophanus Thoe*, *Colias Eurytheme*, *C. Philodice*, *Pamphila Metacomet*, *P. Cernes*, and *P. Mystic* have been reared.

COLEOPTERA.

Considerable additions have been made to the Ottawa lists of beetles, but some of the species are yet unidentified. Among those determined may be mentioned *Oestodes tenuicollis* and *Conotrachelus anaglypticus*. Three specimens of the rare *Staphylinus erythropterus*, only once previously recorded in America, were taken in Dow's Swamp.

HYMENOPTERA.

A large collection, especially of the smaller species, was made at various points in the vicinity of the city, of which may be noted, Kettle Island, the Old Racecourse, Beechwood, the Beaver Meadow and Russell's Grove, near Hull, the Experimental Farm and Dow's Swamp. The Aculeata, or sting-bearers, numbered about 125 species; Phytophaga, or leaf-eaters, 70 species; and Parasitica, at least 200 species, of which a number will probably prove to be undescribed, while many of the others are new to our lists, or of very rare occurrence and special interest.

J. FLETCHER,
W. H. HARRINGTON } Leaders.
T. J. MACLAUGHLIN

OBITUARY NOTICES.

1.—DR. GEORGE LAWSON, PH.D., F.R.S.C., etc., etc., professor of Chemistry and Botany, in Dalhousie College, Halifax, well known to many of the members of our club, with which he has been connected for eleven years, breathed his last at his home in Halifax, Nova Scotia, November 11th, 1895.

At the time of his death Dr. Lawson was President of the Nova Scotian Institute of Science, Halifax, an active member of Section IV of the Royal Society of Canada, of which Society he had the honor of being its President, and in Section IV, where he read valuable papers, chief amongst which is his "Monograph of the Ranunculaceæ." Dr. Lawson was born in 1827, at Maryton, a beautiful village on the banks of the Tay, in Scotland. In his early days he was apprenticed to a solicitor in Dundee, with a view to enter the legal profession. But he had strong tastes for botany and natural history studies. These he pursued vigorously, and came in contact with many scientific men of the times, notably in Edinburgh. In 1849 he was elected to the position of Asst.-Sec'y and Curator to the Botanical Society, and to a similar post in the Caledonian Hoticultural Society. In 1850 he published a work on "Water Lilies," and was appointed secretary and editor of the Scottish Arboricultural Society. He edited the transactions of this last named

Society up to 1858, when he was called to the Chair of Chemistry and Natural History in Queen's College and University, Kingston, Canada West, which position he held for many years, until he accepted the appointment in Dalhousie College, which position he held at the time of his death. Dr. Lawson's genial spirit and kind demeanor won for him many staunch friends and admirers. He was one of the foundation or charter fellows of the Royal Society of Canada, and was chosen as an authority on numerous occasions by his province and country. His loss will be greatly felt by all whose researches had thrown them into communication or acquaintance with him.

2.—DON ANTONIO DEL CASTILLO, F.G.S., F.G.S.A., founder and director of the Geological Survey of Mexico, died on the 27th day of October, 1895, in the City of Mexico. Don Antonio had taken a wide interest in matters geological throughout the world. At the time of his death he was a fellow of the Geological Societies of France, Belgium, London, Berlin and America, a member of the Geographical and Statistical Society, Director of the National School of Engineering, and an active member of the American Institute of Mining Engineers. Notice of the death of this distinguished geologist reached the Ottawa Field Naturalists' Club early in November, and to the members of the Geol. Surv., of Mexico, who kindly sent the news, the Club tenders its deep sympathy and regret.

NOTES, REVIEWS AND COMMENTS.

Geology.—THE SAGUENAY GORGE.—An interesting discussion* has arisen between the Rev. Mgr. Laflamme, A. Buies, P. Horace Dumais and others, as to the geological history of the gorge at the entrance or mouth of the Saguenay.

Mgr. Laflamme and Mr. Dumais both agree in the view that the gorge is an old fjord resembling those of Norway of to-day.

GEOL. SOC. OF AMERICA.——The Eighth Winter meeting of the Geological Society of America will be held in Phila-

*Naturaliste Canadien, Chicoutimi, 1895.

delphia, Penn. U. S. A.; probably at the University of Pennsylvania buildings. The meetings are called to order at 2 p.m. Dec. 26th. Prof. Joseph Le Conte of Berkeley, California is president.

The meeting promises to be unusually interesting and important.

Entomology.—I. The editor of the OTTAWA NATURALIST is indebted to Mr. J. B. Tyrrell of the Geological Survey Staff for one copy each of two important contributions to the Natural History of Canada, viz. :—

(1.) "Canadian Spiders." By J. H. Emerton, (with four plates); from *Trans. of the Connecticut Academy, Vol. IX, July, 1894.*

(2.) Nordamerikanische Hydrachniden, von F. Koenike, *Abhandlungen* des Naturwissenchaftlichen Vereins zu Bremen. XIII., Band 2. Heft. pp. 167-226. Bremen, 1895.

I. CANADIAN SPIDERS.

The collections of spiders examined and reported upon by Prof. J. H. Emerton, comprise the following :—

1. Rocky Mountains, lat. 49° to 52°, from 3,000 to 5,000 feet, J. B. Tyrrell, 1883.
2. Rocky Mountains, near C.P.R., from 5,000 feet, at Laggan, up to 8,500 ft. on the neighbouring mountains. A large collection by Thos. E. Bean.
3. Alberta Territory, lat. 51° to 54°, long. 110° to 114°, J. B. Tyrrell.
4. Saskatchewan River, S. H. Scudder.
5. Lake Winnipegosis, D. B. Dowling, 1888.
6. Lake of the Woods, A. C. Lawson, 1884.
7. Ottawa, Ontario, J. B. Tyrrell.
8. Montreal, Quebec, J. H. Emerton.
9. Interior of Gaspé Peninsula, R. W. Ells, 1883.
10. Anticosti, Magdalen Islands, and several ports around the Gulf of St. Lawrence, from Port Hawkesbury to Mingan Harbour, Samuel Henshaw, 1881.
11. Labrador, Bonne Espérance, lat. 51° 24′, to Triangle Harbor, 52° 50′, John Allan, 1882.

Exactly 100 species of Canadian spiders are described in this interesting report and Prof Emerton states that "as far as can be judged, from the present collections, the spiders of Canada, differ little from those of New England." Out of 61 species, from Labrador to Manitoba, 56 species live in New England ; and out of 48 species from the Rocky Mountains, 27 have been found in New England. Among the spiders of Canada are several species that live but little south of its boundary, and there only at high elevations. The most conspicuous of these is *Epeira carbonaria*, which lives on the Alps in Europe, in the

White Mountains in New Hampshire, and on the Rocky Mountains as far south as Colorado, in all cases above the tree line. In Labrador the same species was found by Packard near Square Island, where the mountains are 400 to 1000 feet high, and bare at the top.

Pardosa Groenlandica has been found as far north as Disco Island, Greenland, and along the coast to the Gulf of St. Lawrence. It is common on the White Mountains, above the trees. In the Rocky Mountains it occurs at 5000 feet, at Laggan and in Colorado at 8000 feet. It is also among the spiders from the Lake of the Woods, andon the Pacific Coast it was found at Portland, Oregon."

"Among the rarer species in these collections," Prof. Emerton says: "there are two Epeiras of the *angulata* group; one: *E. nigra*, resembling the *E. soletaria* described in "New England spiders"; and the other, a small variety of *E. Nordmanni*. Lattey's *pallida* belongs to a genus new to the northern part of North America." Prof. Emerton states that the *Attidæ* were determined for him by Mr. Peckham and include one new species: *Habrocestum montanum* from the Rocky Mountains and those from the Polaris Arctic Expedition were sent to Prof. Emerton by Prof. Packard.

The bibliography of spiders is also discussed and the reference given on pp. 401 and 402. Emerton, Peckham, Hentz, Keyserling, Thorell, Cambridge and Blackwell being the authors who wrote from 1846 to the present time.

Four excellent lithographic plates accompany this paper, drawn from nature by Prof. Emerton himself, and show clearly the crucial and distinguishing characters of the numerous species in question.

Spiders are best collected in small glass bottles and preserved in dilute alchohol. Systematic collecting in the Ottawa district would no doubt reveal a large and important addition to the species named in the list.

Catalogue List of Canadian Spiders described by Prof. J. H. Emerton.

No.	Genus and Species.	Author.	Locality.	Province or District.
1	Epeira nigra	N. Sp.	Laggan, Rocky Mts	Alberta.
2	" Nordmanni	N. Sp.	Gaspé	Quebec.
3	" silvatica	Emerton	Gaspé	"
4	" marmorea	Thorell	Lake of the Woods	Ontario.
			Gaspé	Quebec.
5	" trifolium	Hentz	Rocky Mts., Laggan	Alberta.
	" "		Gaspé	Quebec.
			Entry Island, Gulf of St. Lawrence	"
6	" displicata	Hentz	Rocky, Mts., Laggan	Alberta.
			Anticosti	Quebec.
7	" patagiata	Thorell	Hector	Br. Columbia.
			Lake of the Woods	Ontario.
			Saskatchewan R.	N. W. T.
			Montreal, Anticosti	Quebec.
			Triangle Harbor	Labrador.
8	" sclopetaria	Clark	Ottawa	Ontario.
9	" strix	Hentz	Northern part of	Alberta.
			Gaspé	Quebec.
			Lake Winnipegosis	Manitoba.
10	" trivittata	Keyserling.	Lake Winnipegosis	"
11	" aculeata	Emerton	Laggan	Alberta.
12	" carbonaria	Koch	Rocky Mts., Laggan	"
			Labrador	
13	Zilla montana	C. Koch.	Ship Harbor	Nova Scotia.
14	Singa variabilis	Emerton	Ellis Bay, Anticosti	Quebec.
15	Argiope transversa	Emerton	Ottawa	Ontario.
16	Tetragnatha extensa	Linné	Anticosti, Entry Island	Quebec.
			Saskatchewan R.	N. W. T.
17	Pachygnatha brevis	Keyserling.	Montreal	Quebec.
18	Theridium sexpunctatum	Emerton	English Head, Anticosti	"
19	Steatoda guttata	(Reuss) Thorell.	Bryon I., Gulf of St. Lawrence; Mapisca	Que. & Lab.
20	" borealis	Emerton	Montreal	Quebec.
21	" marmorata	Emerton	"	"
22	" fusca	N. Sp.	Laggan	Rocky Mts.
23	Theridula sphærula	Emerton	St. George's Cove, Gaspé.	Quebec.
24	Euryopis funebris	Emerton	Bet. Lat. 49° and 52°	Rocky Mts
25	Ceratinella brunea	Emerton	Ottawa	Ontario.
			Rocky Mts. (?)	
26	" læta	Emerton	Ottawa, peat bog	"
27	" lætabilis	Emerton	" "	"
28	" minuta	Emerton	" "	"
29	" laticeps	N. Sp.	Near Laggan	Alberta.
30	Lophomma cristata	Emerton	Montreal, under leaves	Quebec.

No.	Genus and Species.	Author.	Locality.	Province or District.
31	Lophomma elongata	Emerton	Ottawa, peat bog........	Ontario.
32	Lophocarenum decem-oculatum.......	Emerton ..	Laggan, 5,000 ft	Rocky Mts.
33	" oculatum....	Emerton ..	Peat Bog, Ottawa	Ontario.
34	Spiropalpus spiralis......	Emerton ..	Laggan	Rocky Mts.
35	Tmeticus plumosus......	Emerton ..	Montreal	Quebec.
36	" pectinatus	N. Sp.....	Laggan	Alberta.
37	Linyphia humilis.........	N. Sp.....	"	Rocky Mts.
38	Linyphia phrygiana	C. Koch...	Rocky Mts.	
			Gaspé	Quebec.
39	Stemonyphantes bucculentus...............	(C. Crick). Thorell....	Lat 51° to 50°.......... Long. 110° to 114°	Alberta.
40	Diplostyla nigrina	(Westr.)... Thor......	Perroquet I........... ..	Labrador.
41	" concolor......	Emerton ..	Montreal	Quebec.
42	" Canadensis ..	Emerton ..	"	"
43	Microneta viaria	Emerton ..	"	"
44	" quinquedentata	Emerton ..	"	"
45	Amaurobius silvestris	Emerton ..	Near Laggan	Rocky Mts.
			Lake of the Woods......	Ontario.
			Gaspé	Quebec.
46	Titanœca Americana	Emerton .	Above Laggan (6,700 to 8,500 ft.)..........	Rocky Mts.
47	Lathys pallida..........	Nap	Near Laggan	"
48	Tegenaria brevis.......	Emerton .	Gaspé	Quebec.
49	" derhamii	(Scopoli).. Thorell.	"	"
50	Hahnia bimaculata	Emerton .	Lake Winnipegosis	Manitoba.
51	" cinerea	Emerton ..	Peat bog, near Ottawa.. .	Ontario.
52	Agalena nævia..........	Walck. and Box.....	Lake Winnipegosis	Manitoba.
			Bryon I., Gulf of St. Lawrence	Quebec.
53	Agroeca repens	N. Sp.....	Laggan	Rocky Mts.
54	Phrurolithus alarius......	Emerton ..	Lake of the Woods	Ontario.
55	Pœcilochroa variagata ..	Emerton .	" "	"
56	Gnaphosa conspersa	Thorell ..	Near Laggan	Rocky Mts.
			Lake of the Woods	Ontario.
57	" brumalis......	Thorell ..	Laggan (abou 5,000 ft.) ..	Rocky Mts.
			Strawberry Harbour	Labrador.
			Ellis Bay	Anticosti.
58	Drassus coloradensis .. .	Emerton	Near Laggan.....	Rocky Mts.
59	" robustus........	Emerton .	"	"
60	Micaria constricta	N. Sp.....	"	"
61	" montana........	Emerton ..	Below Laggan	"
62	Prosthesima atra........	Emerton ..		
63	Clubiona ornata	Emerton ..	Gaspé	Quebec.
64	" Canadensis	Emerton ..	Gaspé, Montreal	"
65	Xysticus ferrugineus	N. Sp. ...	Near Laggan	Rocky Mts.
66	" triangulosus	N. Sp.....	"	"
67	" bimaculatus	N. Sp.....	Above Laggan	"

No.	Genus and Species.	Author.	Locality.	Province or District.
68	Xysticus pulverulentus .	N. Sp.....	Near Laggan	Rocky Mts.
69	Cariarachne versicolor ..	Keyserling.	Collected by Mr. Tyrrell, 1885	"
70	Oxyptuia conspurcata....	Thor......	Peat bog, near Ottawa...	Ontario.
71	Misumenia vatia	Thor......	Anticosti	Gulf of St. L.
72	" aleatoria	Emerton ..	....	Alberta.
73	" asperata	Emerton ..	Gaspé	Quebec.
74	Philodromus bidentatus..	Emerton ..	"	"
75	" inquisitor ...	Thorell...	Laggan	
			Path to L. Agnes, 6,700 6,900 ft......	Rocky Mts.
76	Tibellus Duttonii	Keys......	Laggan	"
			Lake of the Woods	Ontario.
			Ellis Bay..........	Anticosti.
77	Thanatus coloradensis....	Keys......	Mr. Bean's and Mr. Tyrrell's collections.....	Rocky Mts.
78	Phidippus tripunctatus ...	Emerton .	Lake of the Woods	Ontario.
79	Dendryphantes æstivalis .	Peckham..	Fox Bay	Anticosti.
80	" militaris .	Emerton .	Fox Bay and Lake Winnipegosis..........	"
81	Icius mitratus	Peckham.	Near Ottawa............	Alberta.
82	Neon nellii.............	Peckham..	"	Ontario.
83	Attus palustris..........	Peckham..	Ellis Bay.....	"
84	Habrocestum splendens.	Peckham..	Ship Harbor...........	Anticosti.
85	Saitis pulex	Peckham..	Near Ottawa............	Nova Scotia.
86	Habrocestum montanum. (N. Sp.)	Emerton ..	Laggan	Ontario.
87	Lycosa fumosa (N. Sp.)..	Emerton ..	No loc. indicated	
88	" Beanii (N. Sp.)...	Emerton .	Laggan	Rocky Mts.
89	" quinaria (N. Sp.).	Emerton ..	Loc. not. ind.	Alberta.
90	" polita	Emerton ..	Laggan	Rocky Mts.
91	" pratensis	Emerton	Laggan	"
			Lake of the Woods	Ontario.
			Gaspé	Quebec.
			Anticosti	"
			Port Hawkesbury	Gulf of St. L,
92	" albohastata(N Sp.)	Emerton ..	Laggan	Rocky Mts.
93	Pardosa grœnlandica	Thorell...	Labrador	
			Anticosti	Quebec.
			Lake of the Woods......	Ontario.
			Laggan	Rocky Mts.
94	" glacialis	Thorell....	Port Hawkesbury........	Gulf of St. L.
			Laggan	Rocky Mts.
			Bryon I................	Gulf of St. L.
95	" uncata	Emerton ..	Laggan	Rocky Mts.
96	" tachypoda.	Emerton ..	Loc. not indicated	
97	" luteola (N Sp)...	Emerton ..	" "	
98	" lapidicina	Emerton ..	Gaspé	Quebec.
99	Dolomedes tenebrosus...	Hentz.....	Lake of the Woods......	Ontario.
100	" sexpunctatus ..	Hentz.....	" "	"

Mr. Tyrrell, whose researches in hydrachnidæ, sarcoptidæ, etc., are well known to the members of our Club, has kindly prepared the following notice of Dr. Koenike's paper on "Nordamerikanische Hydrachniden" for the NATURALIST.

II. NORTH AMERICAN WATER-MITES.

This report of sixty octavo pages contains a clear and exhaustive description of a collection of Canadian Water-mites, made by Mr. Tyrrell, of the Geological Survey Department, in this city, partly in the vicinity of Ottawa, and partly in the lakes and streams of the Rocky Mountains, between the Canadian Pacific Railway and the International Boundary line.

Dr. Koenike here describes thirty species, belonging to fourteen different genera, sixteen species and one genus being new. The descriptions are illustrated by seventy-two beautiful figures, arranged on two folding and one single plate. The paper will be a classic in the literature of these minute and usually bright coloured inhabitants of clear water, as it contains the first full and systematic description of a collection of Water-mites from North America.

The species of more particular interest to the Naturalists of Ottawa are *Eylais extendens*, the small red mite so often seen swimming among the weeds in quiet water. *Mideopsis orbicularis*, with its clear yellow body, and light red band down the back, was found in Patterson's Brook, near Bank street, on the 20th of January, 1883. *Tyrrellia circularis*, a reddish-brown water-mite, $\frac{1}{20}$ inch in length, with oval or almost circular dorsal outline, found crawling on the mud in a pond at Deschenes, on one of the Field Club Excursions on the 2nd of September, 1882. This species is the type of the new genus Tyrrellia. *Limnesia anomala*, a rather large mite, with sky blue legs found in Meach's Lake. *Atax ypsilophorus* parasitic in the gills of Anodonta fragilis. *Atax ingens*, a milk-white form, as large as a pea, found parasitic in the gills of Anodonta fragilis and Unio complanatus from Meach's Lake. *Atax fossulatus* parasitic in the gills of Unio luteolus from the Rideau river.

Most of the specimens supplied were collected in Alcohol, but water-mites, soft-bodied and generally brightly coloured creatures, are said to be best preserved in a three per cent. solution of Chloral Hydrate.

Genus.	Species.	Ottawa, Ont.	Rocky Mts.
Eylais	extendens, O. F. Mueller	x	
Arrenurus	lautus, n.sp		x
"	interpositus, n.sp		x
"	setiger, n.sp		x
"	krameri, n.sp		x
Aturus	scaber, Kramer		x
Mideopsis	orbicularis, O. F. Mueller	x	
Feltria	minuta, Koenike		x
Thyas	pedunculata, n.sp		x
"	stolli, n.sp		x
"	cataphracta, n.sp		x
Tyrrellia	circularis, n.sp	x	
Lebertia	tau-insignita, Lebert		x
Sperchon	glandulosus, Koenike		x
"	parmatus, n.sp		x
"	tenuipalpis, n.sp		x
Limnesia	undulata, O. F. Mueller		x
"	koenikei, Piersig		x
"	anomala, n.sp	x	
Curvipes	fuscatus, Hermann		x
"	guatemalensis, Stoll		x
Atractides	ovalis, Koenike		x
Hygrobates	longipalpis, Hermann		x
"	exilis, n.sp		x
"	decaporus, n.sp		x
"	multiporus, n.sp		x
Atax	ypsilophorus, Bonz	x	
"	vernalis, Mueller		x
"	ingens, n.sp	x	
"	fossulatus, n.sp	x	

(1) FLETCHER, JAMES, F.L.S., F.R.S.C., "*Practical Entomology*," being the presidential address delivered before the Geol. and Biological Section of the Royal Society of Canada, May 15th, 1895. *Trans. Roy. Soc. Can., Second Ser., Vol. I., Sec. IV., pp. 3-15., 1895.*

This paper, the first published in the new series of the Transactions of the Royal Society, contains a succinct account of the value of scientific knowledge to the practical problems of every day life. The history of economic entomology from the days of Aristotle and Pliny the Elder to those of Muffet in 1634 is given down to the present time, including Linnaeus, Fabricius, Latreille, Curtis, Westwood, Capper, Yeates, Barbut, with Kirby and Spence who followed each other and raised a monument which enables us to ascertain the fundamental and permanent relations which exist between plant and insect life. The work done by John Curtis, founder of the Royal Agric. Society of England, by Miss E. A. Ormerod, one of our Corresponding Members, by Mr. C. White-

hea dare also noticed, after which the interesting digest of work done in economic entomology in Canada is carefully considered.

How to controll injurious insects by remedies, by natural enemies, by vegetable parasites, is then considered at length and the excellent work done by Giard in France, by Snow in Kansas, by Forbes in Illinois, by Thaxter in Massachussetts is recorded. This interesting as well as useful address closes with methods of treatment from an agricultural standpoint and an appeal for systematic co-operation.

(2) The "*Naturaliste Canadien*" is doing good work in distributing useful information in economic entomology. Many of its articles are profusely illustrated by wood-cuts and some of our garden and farm pests can be readily identified by the readers.

H. M. A.

Pictou Academy.—The Academy building, Pictou, Nova Scotia, was struck by lightning in the night of Oct. 29th. and destroyed by fire. We regret to have to chronicle this loss to education and science. All the original collections of fresh water sponges, snakes, as well as minerals, which Dr. A. H. MacKay had made and stored in the Museum and laboratories of the Academy, perished in the flames. We heartily sympathize with Dr. MacKay and with the principal, staff and trustees of the Academy in this loss. We learn with pleasure that the Academy is to be rebuilt with modern improvements. It is earnestly hoped that the building will be a fire-proof one, so that some of the valuable collections of books and specimens which were saved from the flames will not be subjected to such risks.

The collections which we had the pleasure of examining in the Academy, in October 1895, only a few days before the fire, were most valuable and reflected great credit upon Dr. MacKay and the Pictou people who had worked so energetically in building up one of the most important local museums in the country. Donations to the new Academy Museum will soon be in order.

FOSSIL INSECTS FROM THE LEDA CLAYS OF OTTAWA AND VICINITY.

BY H. M. AMI.

(Read before the Club, Dec. 20th. 1894.)

Fossil Insects are of rare occurrence in the calcareous nodules or concretions of the 'Leda clay' formation (Pleistocene) about Ottawa. So far, we know of only *four* species, all of which were described as new species by the eminent authority, Dr. S. H. Scudder of Cambridge Mass. to whose facile pen the world is greatly indebted for valuable contributions to Palæo-Entomology. *Three* of these species were discovered by the writer and one by Sir William Dawson. They all came from nodules collected along the south bank of the Ottawa River, below Ottawa City, and form an interesting series to which will no doubt be added a great many more when the fauna of these rocks is better understood.

The first three species of fossil insects described by Dr. Scudder were *Coleoptera*.

(1) *Fornax ledensis*, Scudder. This species was the first fossil insect found in the calcareous nodules of Green's Creek and was described by Dr. Scudder in one of the reports the Geological Survey of Canada published in 1894. *

It was associated with *Mallotus villosus*, Cuv. or capeling, the most abundant fossil fish in the nodules at the same locality.

(2) *Tenebrio calculensis*, Scudder. †

This species is compared with *Tenebrio molitor* which occurs in North America from Nova Scotia to Mexico and is also found in Alaska.

(3) *Byrrhus Ottawaënsis*, Scudder. ‡

(4) *Phyrganea ejecta*, Scudder. The *fourth* fossil insect discovered in the "Leda Clay" belongs to the Neuroptera. It is a caddis-fly found by the writer in a nodule at Green's Creek, Ottawa R., and has only just recently been described by Dr. Scudder in the Canadian Record of Science, Montreal.

I am indebted to the Editor of the Can. Rec. of Science for advance copies of the description of this fossil insect, also for the block

*Contrib. to Can. Pal., Vol II, pt. 2. p. 39, Pl. III, figs. 3 and 4, Ottawa, 1894.
† loc. cit. p. 31. Pl. III, figs. 1 and 6.
‡ loc. cit. pp. 40 and 41, Pl. II, figs. 6 and 8.

which accompanies the description and serves to illustrate the venation of this insect. The description given by Dr. Scudder runs as follows :—

"The few insects that have been hitherto found in the Leda clays or in similar horizons in America have all been Coleoptera. The present specimen, of which a figure is here given, enlarged six diameters, is a cadis-fly, one of the Neuroptera. It was found by Dr. Henry M. Ami, of the Geological Survey of Canada, in the nodules of Green's Creek and sent me for examination. It is of a glistening, dark, smoky brown color, with black veins which are followed with some difficulty, especially where two wings overlap. The clearest and most important part of the neuration is in the upper portion of the fore-wing ; but unfortunately it exhibits in full only the principal cells. These are enough to show that it is a caddis-fly, and that it falls near, if not in the genus Phryganea proper, but it differs in important points from all the species I have examined in the Museum of Comparative Zoology at Cambridge, containing the large collection of the late Dr. Hagen. The difference consists principally in the great length of the thyridial area and of the median cellule, so that the distal termination of the lower cellules is much farther removed from the base of the wing than is that of the upper. It represents a tolerably large species, the preserved fragment being 10 mm. long and the probable original length of the fore-wing at least 15 mm. It may be called *Phryganea ejecta*."

Phryganea ejecta, n. sp.

THE MICROSCOPICAL SOIREE.

The opening Conversazione and Exhibition of Microscopical objects and Natural History specimens took place on Tuesday evening 26th. November last in the large Assembly Hall of the Normal School, Ottawa, on which occasion there were upwards of 200 persons present. An address of welcome by Dr. J. A. McCabe, M.A., F.R.S.C., Principal of the Provincial Normal School opened the proceedings, after which Dr. R. W. Ells on behalf of the Ottawa Literary and Scientific Society, of which he is president, read a short paper on the future work of societies of this kind in Ottawa in which he strongly urged united effort and advocated the scheme of lectures now carried on in Montreal, known as the "Somerville Lectures" endowed

by the Rev. Jas. Somerville some fifty years ago and requiring only about $5,000.

Mr. F. T. Shutt, M. A., F. I. C., president of the Ottawa Field Naturalists' Club followed in a short and neat address in which he described the good work carried on by the Club in Ottawa, not losing sight of its educating influences in the community. Mr. Shutt's paper it is hoped will be published in *extenso* in a forthcoming issue of the OTTAWA NATURALIST.

Dr. Ami, was then called upon to describe the various specimens on exhibition both in the cases and under the various microscopes in the room.

The following gentlemen had charge of the microscopical part of the entertainment:— Prof. Wm. Saunders, F. R. S. C., Prof. E. E. Prince, B. A. F.L.S., Mr. W. Babbington, Mr. D. B. Dowling, B.A.Sc. Mr. Walter Odell, Mr. Andrew Halkett, Mr. W. J. Wilson, Ph. B., Dr. H. M. Ami, Mr. Marsh, B A, F C.S. Besides the microscopes, Mr.A. McGill, B. A., B. Sc. had on view and in excellent working order a fine Gerhardt spectroscope from Berlin, Germany.

Mr. and Mrs. Beddoe, Miss Lamb and Mr. Miller favoured the audience with vocal and instrumental music during the evening. The musical parts were admirably rendered and appreciated by all.

The winter course is thus open for the season 1894-1895 and if the attendance at the last meeting is an earnest of what it will be at the forthcoming soirées, the success of the whole course is secured.

To the Ottawa Electric Co. and to Mr. Wm. Scott especially we are greatly indebted for so generously putting in the electric wires and lamps for microscopical work *gratis*. The display was most elaborate and satisfactory.

Announcement. - Prof. Macoun and Mr. James Fletcher will take charge of the next meeting or Soirée to be held in the same hall on Thursday, 5th December, 1895. "The value of Botany in Agriculture" will be discussed by the former, and Mr. Fletcher will read a paper on the subject. "A Naturalist in British Columbia." These two papers will be copiously illustrated with specimens. A large attendance is expected.

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ERYTHRITE; STILPNOMELANE *var.* CHALCODITE; CRYSTALLIZED MONAZITE; AND PLEOCHROIC APATITE FROM SOME CANADIAN LOCALITIES.

By W. F. FERRIER, B.A.Sc., F.G.S., Geological Survey of Canada.

(Communicated by permission of the Director.)

Erythrite.

This mineral was detected by the writer in some rock specimens collected in 1893 by Mr. A. E. Barlow of the Geological Survey on the west shore of Rabbit Lake, District of Nipissing, Ont. It occurs in thin earthy crusts, of a dullish peach-red color, lining fissures in a diabase which cuts the Huronian rocks of the locality, and is accompanied by a green mineral, apparently containing nickel and arsenic, which may be the hydrous arsenate of nickel, annabergite, but the available material was not sufficient for a satisfactory determination of its true character to be made.

In composition erythrite is a hydrous arsenate of cobalt containing when pure 38.4 % arsenic acid, 37.6 % oxide of cobalt, and 24 % of water, but the cobalt is nearly always replaced in part by nickel, iron, and calcium.

When abundant it is a valuable ore of cobalt, and its occurrence in Canada has been so seldom noticed* that it was thought desirable to place on record this new locality discovered by Mr. Barlow.

As the mineral almost invariably accompanies other ores of cobalt (sulphides etc.), from whose alteration it is frequently derived, a further examination of the locality is to be wished for, which, even if it did not reveal the mineral in workable quantity, as from its mode of occurrence is scarcely to be expected, might bring to light other compounds of cobalt and nickel of interest to the mineralogist.

* It occurs in thin coatings at Prince's Mine, Lake Superior, Ont., and in some quantity at a new locality discovered by the writer and described by him in the forthcoming Summary Report of the Geol. Survey of Canada.

Stilpnomelane *var.* Chalcodite.

In 1893, amongst some specimens of hematite from the Wallbridge Mine in the township of Madoc, Hastings county, Ont., given to him by Mr. John Stewart, the writer found a mineral which has proved to be identical with that described by C. U. Shepard in 1851 under the name of Chalcodite.*

Shepard's mineral was from the Sterling Iron Mine in Antwerp, Jefferson county, State of New York, where it occurs coating hematite and calcite, and associated with the sulphide of nickel, millerite.

It is a hydrous silicate of iron, aluminium, and magnesium, belonging to the Chlorite Group of Dana's system of classification, but its precise composition is still uncertain.

The material available in the case of the Canadian specimens was not sufficient to admit of a quantitative analysis, but it is hoped that more will be obtained so as to enable this to be carried out. From its physical characters, however, and the results of the qualitative examination there can be no doubt as to the identity of the species. Its name, from the Greek word *χαλκός*, *brass* or *bronze*, refers to its characteristic color which has been well described as resembling that of mosaic gold.

The Madoc mineral, like that from the State of New York, occurs in cavities in the massive hematite, coating small crystals of specular iron and associated with calcite, but millerite has not yet been observed at the locality. It forms rosettes of small foliated plates with a submetallic lustre, some of which are rudely hexagonal in outline. Its color is a yellowish bronze. In the closed tube it yields much water, it is almost completely soluble in hydrochloric acid, and before the blowpipe readily reacts for iron and fuses to a black magnetic globule.

The occurrence of this mineral in Canada has not been hitherto recorded.

Monazite.

Some three or four years ago whilst at the Villeneuve Mica Mine in Ottawa County, Quebec, the writer was fortunate enough to find a

* Trans Am. Assoc. Adv. Sci. Vol. VI, p. 232, 1851.

good crystal of this rare and interesting species which, in its massive form, had been recorded in the Annual Report of the Geological Survey for the year 1886.* An analysis was also published by the late Dr. F. A Genth in 1889 †

The crystal to which I now refer measures about 12 x 8 mm., is flattened parallel to the orthopinacoid, as is often the case in monazite, and is of a clove-brown to reddish-brown color with a decidedly resinous lustre on fractured surfaces. A blowpipe examination and qualitative tests shewed its general composition to be that of monazite.

The faces of the crystal are too rough to admit of precise measurements, but the following planes were determined with a tolerable degree of accuracy:—

$$\infty P\bar{\infty},\ \infty P\breve{\infty},\ \infty \bar{P}3, \infty \bar{P}2,\ P\bar{\infty},\ P\breve{\infty}.$$

The crystal was isolated, imbedded in albite, and was readily broken out from its matrix.

Apatite.

It is a fact not generally known amongst mineralogists that at many of the phosphate mines along the Du Lièvre River, Quebec, beautiful translucent to transparent specimens of apatite are to be found which possess the property of pleochroism in a most marked degree. In an almost transparent cleavage piece measuring 13 x 15 mm. which now lies before me, the color, viewed in the direction of the principal axis of the crystal, is a bluish-green, whilst in a direction at right angles to this it is a rich oily green, the contrast being most marked.

Little cubes ¼ in. and more in diameter have been cut from similar cleavages and serve to illustrate pleochroism, for teaching purposes, to perfection. The only mention of similar crystals from a North American locality which has come under my notice is a short note by Mr. Geo. F. Kunz ‡ on a fragment of an apatite crystal from near Yonkers in the State of New York.

*Ann. Rep. Geol. Surv. Can. 1886, Part T. p. 11.

† Am. Jour. Sci., Vol. XXXVIII, p. 203, 1889.

‡ Am. Jour Sci., Vol. XXXVI, p. 223, 1888.

NOTES ON THE FLORA OF ONTARIO.

By JOHN MACOUN. M. A., F. L. S.

I

The Geological Survey Department has published, during the past ten years, a catalogue of Canadian plants in six parts. The scope of this catalogue was restricted to a bare record of the localities at which our Canadian plants were know to occur with an occasional description of a new species or a note on specific or varietal differences, peculiarity of habit, etc. I had hoped for many years that some botanist residing in Ontario would make a special study of the plants of that province, and give the results of his work to the scientific public. Nothing of this kind has been done, however, and apparently nothing is contemplated. At the repeated solicitation of those who feel the need of such work, I have decided to utilize my holidays and such time as can be spared from my regular duties, in studying and collecting the flora of Ontario. Much has, of course, already been done, but next spring I shall set to work systematically to accumulate material and describe our plants in such a manner that the field botanist may eventually have a field book for field work. Should I not be spared to complete the work, the result of my labors will be kept in such a condition that any competent botanist can continue and complete what I have begun.

My experience as a teacher of botany and the difficulty I have often had in determining plants from descriptions alone, have shown me that amateur botanists and botanical students have a much greater excuse than they themselves suppose, for their frequent inability to name correctly the plants they collect. This difficulty almost invariably arises from inadequate or misleading descriptions and a failure on the part of those who write them to clearly state the essential differences between the species they describe and nearly related ones; old names and old descriptions are also frequently made to include plants they were never intended to cover and which should be re-described and occasionally re-named.

In a hurried compilation of the flora of Ontario I have enumerated 1633 species of flowering plants and ferns as being found within the borders of the province and the tabulated statement below shows the numerical relation between the plants of Ottawa and its vicinity and the Province of Ontario. It is not pretended that all the species in either region is given but the estimates are under, not above, the actual number. The Ottawa destrict is intended to included an area of 30 miles around Ottawa.

TOTAL NUMBER OF	ONTARIO.	OTTAWA.
Species	1633	968
Herbaceous Plants	1409	821
Shrubs	139	96
Trees	85	51

In future numbers of the NATURALIST notes on critical species and the results of some of our studies will be printed, and Western Quebec will, on account of its close proximity to Ottawa, be also confidered.

ADDRESS BY THE PRESIDENT OF THE OTTAWA FIELD NATURALISTS' CLUB—MR. FRANK T. SHUTT, M.A., F.I.C., F.C.S.

AT THE CONVERSAZIONE HELD IN THE ASSEMBLY HALL OF THE NORMAL SCHOOL, 26th NOV., 1895.

Mr. Chairman, Ladies and Gentlemen.

We decided—and I think wisely—that this the first evening of our winter programme should take the form of a conversazione: an occasion when ample opportunity would be afforded our members for friendly intercourse and the consideration and enjoyment of the many and varied objects of Natural History displayed. It is not my intention therefore to speak at any length to-night. In the few words I have to say, however, it is my wish, with your permission, to bring before you the objects and functions of the Society of which I have the honour to be president—THE OTTAWA FIELD NATURALISTS' CLUB—pointing out the advantages to be derived by those members who take a real interest in her work and asking you to consider the claims which our Society, as an educational institution, has upon the citizens of Ottawa.

The principal object of the Club is, I take it, to inculcate a greater love for and interest in Nature as she is manifested in the plant and animals about us, fostering a

closer and more systematic study of the many forms of life with which this earth teems, and of the earth which gives them a habitation. The chief function of the Club is to assist in this study all deserving help, by lectures, by our publication, by field excursions and by such evenings as the present, when the wonders of the earth and sky and sea are revealed under the searching power of the microscope.

It would seem to me that a society fulfilling such an object, performing such a function —and I trust I am sincere in saying that the club is striving to do both—is doing a great and a good work. And perhaps more especially in these latter times is this a noble work, for it appears to me that now-a-days the majority of people divide their time between the getting of money or position and the following of the lighter recreations. While undoubtedly both of these should find a place in the programme of one's life, it is certainly a grave mistake to allow the serious matters of life and what I may term its evanescent pleasures to control all our energies, to absorb all our time and talent. I would make a strong plea for the study of the Natural Sciences—Zoology, Botany and Geology—not from a utilitarian standpoint, though on that score it could be urged with a good deal of emphasis—but for the reason that it is a study of great educational value, improving and developing as no other branch of learning can, the faculties of observation and deduction—faculties that expand the mind improve the memory, sharpen the critical power and stimulate good judgment. It is a study that not only stores our mind with useful and interesting data of great service in this eminently practical age, but one also that opens new avenues of real and lasting enjoyment: vivifying the imagination and awakening our admiration in the revelation of the wonderful but often hidden phases of life that everywhere abound. These avenues are closed as with a five-barred gate against the money getter and that chip of humanity that floats, tossed here and there on the sea of frivolity. Further, I believe that the study of the life habits and life mechanism, and function of plants and animals has a distinct ethical value; but of this, I must not allow myself to speak on this occasion. May I sum up my arguments by saying that the study of the Natural Sciences is worthy of a place side by side with the Classics and with English, as an educator not only of practical value but also as one leading to the best and truest culture.

Our club had a small beginning some sixteen years ago, but its growth has been steady, its progress and development very satisfactory. Instituted by a few earnest enthusiastic gentlemen determined to study Natural History and to help one another in their work, it has now grown to a Society of no mean standing. It can point to an honourable and valuable record in its journal of the progress that has been made by her members in the study of the flora and the fauna and the geology of this district. We have a membership roll of between 200 and 300 and an annual and entirely free course of lectures on Natural History subjects; we have during the summer months field excursions in the environs of Ottawa—which are opportunities for practical work when the assistance of our leaders is always available for the determination of the specimens collected.

At the present time we are looking to an increased membership, in the hope of being able to still further improve the "OTTAWA NATURALIST," our official organ. Both in appearance and make up, it is now deserving of the highest commendation; but we are anxious to enlarge it and its scope. To mention but one feature—we should like to devote a number of pages monthly to the review of current work in Natural Science the world over. In our present condition, such an advance is impossible. We are entirely self-sustaining, be it remembered. The Club receives no grant or annuities; we must therefore look to a further co-operation on the part of our citizens before we can take this next step forward. I may be allowed to say as one who knows the workings of the Society intimately, and certainly not in any sense of boastfulness—that I do not know of any association in Canada that has more to offer for its annual subscription ($1.00), or of any society in the country that has unaided done more *pro bono publico* than the OTTAWA FIELD NATURALISTS' CLUB.

Our membership is by no means restricted, as might be thought by some, to those who in the professional sense of the term man be called scientists. We are certainly particularly fortunate in having among our members many who are devoting their time exclusively to the study of scientific problems. We are glad that those of the scientific branches of the Government service as well as those in the various educational institutions of the city, are with us in our work, taking an active interest in the Club's welfare and extending always a helping hand to the novice, a feature which I feel sure you will recognize as characteristic of our Club. Nevertheless, we invite all; for are we not all learners? The old and the young alike may find an interest in the fascinating study of Nature. We have on all occasions extended a warm welcome to the Students of the Normal School, and they have always responded well to our invitation. May we not confidently hope that by their attendance at our meetings we have sown good seed that will bring forth fruit in many a distant corner of the Dominion. The Club's influence for good, therefore, extends far beyond the confines of the Capital.

But, whether I have said enough or not to induce our friends to join us, I wish it to be distinctly understood that all—non-members as well as members—are invited to this course of lecture that we inaugurate to-night—all are welcome. In the fullest sense of the word the lectures, as they always have been with the Field Naturalists' Club, are free. We hope for and expect large attendances. By your regular attendance you may accrue a benefit otherwise unattainable; by your presence here you will show your appreciation of the efforts of those who have of their generosity placed their time and talent at our disposal in preparing and delivering the addresses. The programme is one of unusual merit, embracing subjects of great interest. The lectures throughout will be of a didactic character, and many of them will be illustrated by lime-light views. Our lecturers are those whose names are well known in Canadian science and literature. Let us see to it that we show them our appreciation by our attendance and attention.

If we will do this, I can promise a successful season and one that we can look back upon as one of the pleasantest and most instructive in our history.

With an expression of thanks to those who are assisting us, I will bring this short address to a close. First, to the chairman of the evening, Dr. MacCabe, Principal of the Normal School, one who has for many years past taken an active and real interest in the work of the Club and to whose kindly office and influence with the Hon. Minister of Education we are indebted for the permission to use the Assembly Hall for our winter course of lectures. And then to Mr. Scott and the Ottawa Electric Light Co. for their generosity in supplying on such a magnificent scale the brilliant illuminant that we are using to-night to light up our microscopic objects. No little of the success and *éclat* of this conversazione is due to the fact that these gentlemen put at our command the electric lamps which to-night serve such a useful and ornamental purpose. And lastly I may be allowed to tender our thanks to those ladies and gentlemen, Miss Lamb, Mrs. and Mr. Beddoe and Mr. Miller, who of their goodness have made our programme so entertaining by vocal and instrumental numbers. We have enjoyed and appreciated their efforts on our behalf and I know I may assure them not only of our sincere thanks but also that they have very materially added to the pleasures of the evening.

ADDRESS BY DR. R. W. ELLS,

President of the Ottawa Literary and Scientific Society.

At the Conversazione given by the Literary and Scientific Society and the Field Naturalists' Club, at the opening meeting of the joint lecture course for the present season, Dr. Ells, the president of the former, in a brief inaugural address touched upon the work and aims of the two societies represented. In the course of his remarks he said :—

"The inauguration of the present lecture course, under the joint auspices of the Literary and Scientific Society and the Ottawa Field Naturalists' Club naturally calls for a word of explanation. For some years the feeling has existed and has been frequently expressed by many members of both societies, that their interests, and those of the public generally, or at least of those who have been our patrons in the past would be better served if some scheme of federation or affiliation could be arranged, by which the energies of both societies could be concentrated, and the interest in the lecture courses could be maintained to the end of the season, rather than that it should diminish, as has been unfortunately too often the case. For it will, I think, be conceded by everyone interested in the question, that so many lecture courses are given in the city every winter, by societies and church organizations, that the public interest in these is apt to grow weak and the attendance poor, except in very exceptional cases. In view of this fact it seemed advisable to the boards of management that the two societies here represented, should amalgamate the lecture

courses, hitherto separately given by each, every winter, and to give one really good course of eight lectures which shall be made as attractive as possible.

While we are happy to be able to number on the membership rolls of both these societies, many names, distinguished both in literature, science and art, it must be admitted, as indeed is the case unfortunately in many other societies, that the part taken by many of these is not so active as could be desired.

The advantages posssessed by a city like Ottawa, for becoming the centre of literary and scientific life and thought for our Dominion, have not, I believe, except by a comparatively few, been fully appreciated. The presence of the Geological Survey is sufficient guarantee to show that a large number of men, proficient in all the branches of natural science, are available, while in the other Government Departments are many men of world-wide reputation in the various departments of science, literature and art. When to these we add the large staff of highly educated men and women who control our numerous schools, and those who enjoy widely extended fame in the professions of law, medicine and theology, we have a list of names, such as, if their varied talent could be brought into our society, would render that society unsurpassed anywhere in Canada at least.

For several years a movement has been on foot, tending towards the federation of all the existing societies, in so far at least as that by joint action, some suitable building might be provided which would constitute a home or head quarters for all. So far, I regret to say, the movement has not been successful. This, I feel, is greatly to be regretted, since now we have this unfortunate state of affairs, that some ten or twelve societies, several of which have similar aims, have to hold their regular meetings in as many different places, often under very considerable disadvantages and under conditions which seriously interfere with united action on their part.

The Literary and Scientific Society is among the oldest of the societies in Ottawa. Founded in 1869 it has always maintained a somewhat prominent place in the affection of the Ottawa public. It now has a very good library of over 3,000 volumes in which nearly all the departments of science and literature are represented, with a well supplied reading room, where the leading periodicals and journals can be found. The membership of the society is now about 300, but this, with its low membership fee of only $2.00 per year for all its privileges, is sufficient to meet the necessary running expenses, only by the exercise of the greatest economy, even with the addition of the small grant of $400.00 a year which it receives yearly from the Ontario Government.

The society is also badly handicapped in not being able to secure suitable rooms for its operations, which must be central and easy of access, and also furnish space for our lecture courses. And though efforts have been made year after year to obtain proper permanent quarters, so far we have not succeeded. For some years, through the generosity of one of our life members, the late Col. Allan Gilmour, the funds and corresponding usefulness of the society were greatly aided by his donation of $500.00

annually by which means our library shelves were largely replenished. Since his death we regret, to say, this donation has not been renewed, and as a consequence great care in the management has been necessary lest, in discharging our obligations to our members, serious financial difficulties be met.

In the City of Montreal, the Natural History Society, which has been in existence for nearly seventy years, has been doing work on very much the same lines as our own societies. It has this great advantage, however, that it has a local habitation as well as a name. It owns a fine building, containing museum, library and lecture hall, which, purchased years ago when property was cheap, has now become a very valuable asset indeed. That society, however, enjoys the further advantage of having an endowment for lecture purposes. In 1837 the Rev. Jas. Somerville, of Montreal, at his death left the sum of £1,000 currency to maintain an annual course of lectures in connection therewith, which should be free to the general public. As a result a special course of six lectures, called after his name, the Somerville course, is delivered each winter, principally upon scientific subjects, which have become a regular feature of the society's work and by their excellence these have secured an average attendance which is highly gratifying to the institution which has the matter in charge. Such an endowed course should be established in our city through the generosity of some of our large-hearted and wealthy citizens, so that the best talent available in this direction might be secured. If, indeed, this result could be accomplished by the Literary and Scientific Society, the advantages to that institution would be very great indeed, and the society instead of being, as at present, largely a reading room and a medium for circulating light literature, would be foremost in the matter of furthering the interests of the highest education. Such a course of lectures should be free to the public, and it is to be hoped that before long we shall see arise in our midst a Canadian Carnagie, who, having made a fortune in our city, shall become impressed with the desire to benefit his fellows: some Ottawa Carnagie who, following the example of the Pittsburg magnate, will erect and endow a magnificent library, music hall, and art building, in which all our societies can find a home: where art exhibitions, conversaziones, lectures, musical recitals, etc., shall be given, whereby such an impetus would be given to the development of a taste for literature, science and art, as would make the name of Canada's fair capital illustrious throughout the entire continent.

In the meantime, however, our warmest thanks are due to the Principal of the Normal School, Dr. MacCabe, and to the Minister of Education for Ontario, for their courtesy and consideration in extending to us, for the present course of lectures, the use of this fine hall, and thus enabling us to present our several evenings' entertainments in the most favorable manner, not only to our own members but to all interested therein. It is needless to say that all the entertainments and lectures are free of charge, and that all the students of the Ottawa Normal School are most cordially invited to be present whenever it is possible for them to do so.

I would also, on behalf of the Literary and Scientific Society, tender our most hearty thanks to our worthy member, Mr. Wm. Scott, and to the Electric Light Co. for their kindness and liberality in providing us the present beautiful arrangements for lighting our microscopic exhibit, thus making our evening so much more pleasant and attractive.

There is one other item in connection with the proposed scheme of affiliation which I would like to mention before I close, viz., that of the publication of a scientific and literary journal. The only publication of the kind now in Ottawa is that issued by the Ottawa Field Naturalists' Club, which has now appeared regularly for about fifteen years. As however, this journal is published simply through funds derived from membership fees in the society, at a nominal price of only $1.00 a year, the possibilities of its expansion are not great, though many excellent papers pertaining to most of the departments of natural science have appeared from time to time in its pages. It ought to be possible, however, in a city like this, possessed of such a varied array of talent, to issue not only the best journal in Canada, but one which shall equal any in the adjoining republic. A journal which would embody the results of the operations of the large staff of explorers in the Departments of the Interior and the Geological Survey would be of the greatest possible value in bringing to the knowledge of Canada and the world at large, the extent, physical features and resources of our own country, and would thus make widely known a vast store of information much of which is now locked up in the Archives of the several Departments, or appears from time to time in some blue book, in which form, it is allowable to say, it does not always receive the publicity it demands. In this way also could be made known the most interesting points in connection with the life history of our insects, birds, plants, fishes, etc., the development of our mineral resources, the geographical structure of the country, or the elucidation of many problems of a more strictly scientific character ; while the discussion of literary subjects could also be taken up and our most important lectures permanently recorded. For all this we have a store of information and a staff of workers in this city unsurpassed anywhere on this continent. At the present time, however, owing to lack of facilities for publication here, many papers of great value are written for and published in foreign journals, either in England or in the United States, and consequently Canada is, to a large extent, deprived of the credit she should receive in this connection. Much of the proposed improvement in existing conditions could be brought about if a scheme of centralization and fusion of all our forces could be effected.

I trust I have not wearied your patience by too lengthy explanation of this scheme, and I hope the time is not far distant when some of our hopes or dreams in this direction may be realized. In the meantime, on the part of the Literary and Scientific Society of Ottawa, I most cordially welcome you all to the present conversazione, and trust that this hall will be well filled at each subsequent meeting of the joint course of lectures throughout the present season.

"CANADIAN SPIDERS." *

In looking over his collection of Canadian spiders, a few days ago, Mr. J. B. Tyrrell, of the Geological Survey Department, Ottawa, noticed quite a number of interesting Canadian localities for certain forms which had been carefully named by Prof. Emerton—but inadvertently omitted in his paper noticed last month. In this connection Mr. Tyrrell has very kindly furnished the following note for THE OTTAWA NATURALIST:—

"The following localities shou d be added to the list of those given in the Review of Prof. Emerton's "Canadian Spiders" in the December NATURALIST:—

No.	Genus and Species.	Author.	Locality.	Collector.
4	Epeira marmorea	Thorell ...	Ottawa	Tyrrell.
5	" trifolium	Hentz	Ottawa.................	"
7	" patagiata	Thorell ..	Ottawa	"
14	Singa variabilis	Emerton ..	Alberta	"
20	Steatoda borealis	Emerton ..	Rocky Mts.......	"
52	Agalena nævia..........	Walck. and Bosc....	Gaspé.................	Ells ....
56	Gnaphosa conspersa	Thorell . .	Alberta	Tyrrell......
62	Prosthesima atra........	Emerton ..	Lake of the Woods	Lawson .....
88	" Beanii (N. Sp.)..	Emerton ..	Lake of the Woods.	Lawson .....
94	Pardosa glacialis........	Thorell....	Rocky Mts.......... ..	Tyrrell......
96	" tachypoda	Emerton ..	Gaspé..	Ells ....

PECKHAM, GEORGE W. AND ELIZABETH G.—"*Attidæ of North-America.*" Trans. Wis. Acad. Sci. Art. and Letters, Vol. VII. pp. 104 with 6 plates, Madison. Sept. 1888.

In this paper the authors give an excellent résumé of the family Attidæ, or jumping spiders, after which they give a table showing the distinguishing characteristics of the different genera.

The authors then identify or describe 69 species belonging to 31 different genera, collected from different parts of the United States and

*See OTTAWA NATURALIST, Vol. IX., pt. 9, p. 182 et seq., Ottawa, December, 1895.

Canada. The species of more especial interest to Canadian readers were collected by Dr. A. C. Lawson on Lake of the Woods, and by Mr. J. B. Tyrrell in the vicinity of Ottawa. They are shown in the following table :

LIST OF ATTIDÆ FROM CANADA.

Phidippus morsitans, ...	Walck	Lake of the Woods.....
Philæus militaris	Hentz.	Ottawa. ....
Dendryphantes capitatus...........	Hentz...........	" ....
" " flavipedes, (N. Sp.)	Peckham........	Ottawa?.............
Icius mitratus.......	Hentz..........	Ottawa. ....
Habrocestum cristatum............	Hentz...........	Lake of the Woods.....
" splendens.....	Peckham	Ottawa ....
Siatis pulex....	Hentz...........	" ....
Neon Nellii, (N. Sp.)	Peckham........	" ....

NOTES, REVIEWS AND COMMENTS.

Biology—WILSON, EDMUND B., Ph. D., etc. with the co operation of Edward Leaming, M. D. F. R. P. S. "*An Atlas of the Fertilization and Karyokinesis of the Ovum.*" Columbia University Press, Macmillan & Co., New York City, 4to with ten plates. This work is an admirable contribution to science, with special reference to the early history of the ovum of the American sea-urchin (*Toxopneustes variegatus*). After difficult experiments in the selection of a reagent which would preserve, as Prof. C. S. Minot remarks, (Science, N. S., Vol. 11. No. 47. p. 695.), "the living organization of the ovum with a minimum of change, hundreds of these minute eggs, all in the same stage, were imbedded at once, and sectioned together, leaving chance to determine that some of them be cut in favourable planes The sections were made as thin as practicable and were colored by Hardenhain's iron haematoxyline stain." The "reagent was a mixture of 80 parts of concentrated aqueous solution of corrosive sublimate and 20 parts of glacial acetic acid." Two hundred micro photographs were taken of the best sections and forty have been selected and reproduced as phototypes.

In his interesting review of Dr. Wilson's work—Prof Minot. (*loc. cit. supra*), says:—"the forty phototypes, by themselves, suffice to give a

complete history of the maturation, fertilization and early segmentation of the ovum," and continues by pointing out that although less clear than published drawings—they are absolutely accurate and free from that element of personal interpretation which is unavoidable in every drawing no matter how conscientiously made

The work is most welcome to all students of biology in whatever department or field of research they may be working; and the authors can congratulate themselves upon this most important contribution to pure science.

Geology—WHITEAVES, J. F.—"*Notes on some fossils from the Cretaceous Rocks of British Columbia, with descriptions of two species that appear to be new.*" Can. Rec. Science, April, 1895, 5 pp. Plate II. Contains descriptions of three species of Cretaceous fossils from Hornby and Denman Islands, in the Straits of Georgia. They were collected by Mr. Walter Harvey of Comox. V. I. and sent to Mr. Whiteaves for determination. The species are:—

(1) *Anisoceras Vancouverense*, Gabb—sp.—a species closely related to *Hamites Fremontii*, Marcou, and also to *Anisoceras armatum* of Sowerby. Mr. Whiteaves further states "that the fragment from Comox described and figured by Meek as *Heteroceras Cooperi*, is probably a small piece of the abruptly bent part of *Anisoceras Vancouverense*.

(2) *Heteroceras Hornbyense.* This provisional name is given to the broad turbinate and dextral shell from Hornby Island, B.C. discovered by Mr. Walter Harvey in 1894. In discussing the relations between *Heteroceras* and *Anisoceras* Mr. Whiteaves states:— "It is, perhaps, doubtful whether the distinctions between *Heteroceras* and *Anisoceras* can be maintained. In the one the earlier volutions are said to be in contact while those of the other are described as separate and as forming an irregular open spiral." .... It is also suggested that *H. Hornbyense* Whvs., may possibly be the early stage of large individuals of the preceding species."

(3) *Heteroceras perversum.* A sinistral shell — but in other respects similar to *H. Hornbyense*, Whvs.—from Hornby Island, B. C. collected by Mr. W. Harvey, 1894.

Accompanying this paper is plate II which contained a process cut of *Anisoceras Vancouverense*. Gabb sp., four-fifths of the natural size.

WHITEAVES, J. F.—"*Descriptions of eight new species of fossils from the (Galena) Trenton Limestones of Lake Winnipeg and the Red River Valley.* Can. Record of Science, July, 1895, 11 pp. Montreal, Que. As the title implies, this paper contains descriptions of eight new species of Trenton fossils from the Manitoban region of Canada. It is printed in "advance of an official report on the fossils of the Cambro-Silurian rocks of Lake Winnipeg and its vicinity." The following species are therein described :—

ALGÆ.

1. Chondrites patulus,
2. " cupressinus,
3. " gracillimus,

CŒLENTERATA.

4. Streptelasma robustum,

MOLLUSCOIDEA.

5. Rafinesquina lata,

MOLLUSCA.

6. Ascoceras costulatum,
7. Cyrtoceras laticurvatum,
8. Eurystomites plicatus.

They were obtained for the most part by various officers of the Geological Survey of Canada who have visited those regions at different times and include forms collected by Messrs Tyrrell, Weston, Dowling, Lambe and Bell.

COLEMAN PROF. A. P., F.R.S.C., etc.,—"*Glacial and Inter-glacial deposits near Toronto.*" Journal of Geology, vol. III, No 6., pp. 622—645. Sept.—Oct., 1895. In this paper Dr. Coleman gives us the result of his studies on one of the most interesting sections of glacial deposits to be found in eastern Canada. He begins with a description of the excellent sections exposed for nine miles and a half along the north side of Lake Ontario from Victoria Park to the mouth of Highland Creek. In the lower stratified clay are found numerous fossil remains including boreal species of mosses and swamp-loving trees associated with a remarkable extinct insect fauna. Twenty-nine species have already been recorded by Dr. Scudder from these beds. In the overlying sands two species of shells were found : one freshwater and one land. On p. 634 a section of the quarry at Taylor's brickyard, Don

Valley Toronto, is given, showing at the base, the Hudson river shale; dark or lowest till; fossiliferous stratified sand and clay; middle till; lastly, upper stratified unfossiliferous clay.

In a former paper on the "*Interglacial fossils from the Don Valley, Toronto*" by Dr. Coleman,* that author presents to his readers the extinct faunas and floras of the various formations in that district and indicates the work done by Sir Wm. Dawson, Prof. Penhallow, Dr. W. H. Dall and Mr. C. T. Simpson, the last two, of the Smithsonian Institution, Washington. This paper and the one under present consideration are important contributions to a most interesting section of cenozoic geology.

ADAMS, FRANK D.—"*A further contribution to our knowledge of the Laurentian*;" American Journal of Science, Vol, L. Art. VII, pp. 58-69, with plates 1 and 2, New Haven, July 1895.

This timely article by the well known professor of Geology of McGill University brings forward a summary of results obtained from observation and study both in the field and in the laboratory of the Archæan rocks exposed in the region to the north of the city of Montreal. The information was chiefly obtained while acting as field geologist on the Geological Survey of Canada, the facts and deductions acquiring additional weight from the author's well known ripe petrographical knowledge and a varied experience with the various problems connected with the composition and genesis of Archæan rocks.

This paper opens with a general description of the delimitation of the two great subdivisions of the Archæan—Laurentian and Huronian—as developed in the Dominion of Canada. The origin and composition of the gneisses constituting the Laurentian are the chief points considerd and the various facts relating thereto obtained by a careful examination in the field as well as a critical microscopic study of one hundred and sixty typical specimens representing as far as possible all varieties of the rocks occurring in the district. The region in question lies to the east of that examined by Logan and later by Ells and comprises an area composed of 3500 square miles underlain by the crystalline rocks of

* American Geologist, Vol. XIII, pp. 85—95, Feb. 1894.

which about 1000 square miles is anorthosite occurring as a series of great intrusions.

As a result of the various petrographical examinations undertaken, Dr. Adams has divided the rocks occurring there into four classes.

1. Anorthosites and granites of igneous origin.

2. "Augen" gneisses, granulites and foliated anorthosites, genetically connected with the last group and largely if not exclusively of igneous origin also. The structure characteristic of this class is the cataclastic or granulated structure formed by the mechanical breaking down of the web of the rock under movements induced by great pressure, which movement produced in the rock a foliation more or less distinct according to their intensity. By "leaf gneisses" are understood very finely foliated gneisses very rich in orthoclase and containing numerous thin leaves of quartz—they are usually almost free from iron-magnesia constituents.

3. A series of crystalline limestones and quartzites together with certain geneisses usually found associated with them and which are probably wholly or in part of sedimentary origin. In these rocks the granulated structure is very subordinate or entirely absent. They are characterized by a very extensive recrystallization with the development of new minerals, they also differ from the rocks of classes 1 and 2 in chemical composition.

4. Pyroxene gneisses, pyroxene granulites and allied rocks whose origin is as yet doubtful.

In regard to class 2. there can be no doubt as to their origin as all possible gradations may be seen from the massive variety in which the structure is that of an ordinary plutonic rock to those perfectly foliated were the rock is seen to be in an advanced stage of granulation.

The quartzites included under the *third class* referred to as forming part of the Laurentian are entirely crystalline and nothing has been detected which distinctly proves them to be of clastic origin although so eminent an authority as Professor Rosenbusch is quoted as saying that the specimens from one locality present structures which indicate that the rock was originally a sandstone.

The gneisses which are as a general rule intimately associated with the limestone are quite different from those of the *second class* they are almost all highly garnetiferous and frequently consist essentially of garnet and sillimanite. Quartz and othoclase are present in subordinate amount, some of them contain pyroxene, scapolite and other minerals. These gneisses show no granulated structure, the minerals constituting them have crystallized under the influence of the pressure which has granulated the gneisses of class 2, and are not in any marked manner deformed by it.

These rocks are generally well banded ; this structure being much more pronounced than the foliation, and graphite, which does not occur in the igneous granulated gneisses of class 2, is very frequently present and often abundant.

Complete analyses are furnished of four specimens of these gneisess from various localities throughout the district under examination. Two of these have the composition of ordinary roofing slate ; a third, highly quartzose, bears a very striking resemblance in composition to the more silicious bands so often found in slate quarries. The fourth of these gneisses (from Rawdon) differs entirely from the others and if it is an altered sediment it is one which has suffered very little leaching during deposition and must have been of the nature of a tufaceous deposit or one formed from the rapid disintegration of an igneous rock having the composition of a basic trachyte or syenite.

The gneiss of Trembling Mountain like many others including some in the Grenville series has undoubtedly the composition of an igneous rock being simply granite which has undergone deformation by pressure.

It is impossible in the brief space allotted to a review to even mention all of the important results obtained from these studies but a careful perusal is recommended to every worker, and sudent interested in the difficult problems of Archæan geology.

A. E. B.

Our Club has just received from the author a most interesting book entitled "The History of Mount Mica of Maine, U. S. A. and Its Wonderful Deposits of Matchless Tourmalines" by Augustus Choate Hamlin,

M. D., who, in 1873, published a smaller work dealing largely with the same subject under the title "The Tourmaline."

The present work, consisting of 72 pages, is divided into seven chapters and illustrated with portraits of the author and his son (lately deceased, and to whom, jointly with the author's father, the book is dedicated), two views and two diagrams of the locality, and a series of 43 superb coloured plates of the wonderful tourmaline crystals which have been found there.

The subject matter is divided into seven chapters, of which the first five give a detailed account of the development of the locality from the time of its accidental discovery by two young students, E. L. Hamlin and E. Holmes in 1820, down to the present year; the sixth chapter gives a description of the deposits and the occurence of the tourmalines etc., with remarks on their forms and colours; and the seventh chapter explains the various excavations which have been made and describes the colored plates.

Some of these plates represent *restored* crystals, but in these instances outline plates are also given shewing the actual appearance of the broken crystal.

Scientists in general and mineralogists in particular owe a debt of gratitude to Mr. James A. Garland of New York, whose liberality, the author tells us, has not only placed many of the choicest crystals of tourmaline in the cabinet of Harvard University but has also rendered possible the production of the superb coloured plates with which the work is illustrated.

As one who has repeatedly visited Mt. Mica, collected its wonderful minerals, and enjoyed the privilege of examining many of the matchless specimens described, the writer of the present notice can cordially recommend this little book as most interesting and delightful reading, dealing as it does with subjects which are of interest not only to the mineralogist but to every lover of nature.

W. F. F.

MARSH, O. C. PROF. (2) "*On the affinities and classification of the Dinosaurian Reptiles.—1.* "*Restoration of some European Dinosaurs, with suggestions as to their place among the Reptilia.*" American

Journal of Science, Vol. I, pp. 483 and 498 ; (1) plates V-VIII; (2) plate X, New Haven, Nov. and Dec. 1895.

These two admirable papers contain a large amount of most valuable and timely information on a group of "Extinct Monsters," the affinities of which are fast becoming better known as more perfect and ample material is forthcoming in the remarkable discoveries of recent years.

Ornithology—BLUE-BIRD—DICKCISSEL—I see by a recent number of the OTTAWA NATURALIST that the Blue-bird, *(Sialia sialis)* is no commoner in Ottawa this year than it is in Western Ontario. Very early in the season murmurs of a shortage began to arise, and it was the 23rd of May before I saw one at all, though one pair was known to be nesting near town before then, and four were all I saw during the summer. Observers near Lake St. Clair write that there were a few in that region, and the reports of others coincide with my own observations in noting quite a number in the fall migration in October.

Recent reports in "Forest and Stream" state that the Blue-birds died in Georgia by hundreds in the severe frosts of last winter, and an editorial footnote to a recent letter about the Blue-bird, said that a friend in South Florida sent the information that, contrary to the customary order of things, the blue-birds remained there during the year, nesting in great numbers.

Coupling this with the observation of occasional flocks from the North this fall, one is led to hope that they will not be so rare next year as they were this summer.

An interesting problem arises about which one can do little but theorize. In a given area, say a square mile, let us grant that there were in 1895 one hundred pairs of Blue-birds. These laid 4, 5, & 6 eggs per pair, and probably each pair brought an average of at least three young to maturity In June then, there were 500 Blue-birds where in April there were but 200. In the following year there were but 100 pair again, for Blue-birds have not been growing in abundance nor have they been materially extending their range. Therefore, there had been a mortality, approximately of about 60% of all the birds between June

1890 and April 1891. Accident, carnivorous birds, man, disease, and other foes had accounted for more than half of them. This was repeated in '91'92,'93, and '94; but in '95 that square mile had probably not more than 10 birds in June. It is an interesting speculation whether the old ratio of mortality will hold good, or will a greater proportion of Blue birds escape this year than usual. As an off-set of this loss, it seems you have the Dickcissel (*Spiza americana*) at Ottawa this year. About the middle of June I had a card from Mr. Robert Elliott, stating that at Mr. Beck's farm, about 12 miles from London, there was a nest of the Dickcissel with 5 eggs, and asking me to come and see it. As it was the first record for our county, I decided I would go. On June 21st I left London about 5 a.m. and had not ridden three miles when I heard a Dickcissel along the roadside, and, dismounting, heard another immediately. Two males were singing in an orchard, and after looking in vain for the females who were doubtless on their eggs, I finished the journey and found the pair of birds on Mr. Beck's farm with eggs nearly ready to hatch. Mr. Beck is a lover of birds and had spent a good deal of time watching the strangers and finding their nest. Of cliff swallows,* which are quite rare all through these western counties where they were formerly so abundant, Mr. Beck has a fine colony of perhaps 50 nests, one or more being placed on every building and shed on the farm, save one. His skill with the rifle and shot gun, coupled with a genuine Canadian hatred of the English sparrow has left him with this fine colony of swallows while his neighbors are bereft of them.

It was curious that on my return home at noon, I should receive the first notice of the Ottawa birds, and still more curious that on the next day, 7 miles west of London, I should hear another male singing beside the railway track. Later on I found another one twenty miles south and I have been wondering ever since if I had been deaf to Dickcissels in the early spring.

When I reached Ottawa on July 12th the chief Dickcissel on the Experimental Farm greeted me on my arrival with his monotonous song, which he kept up till the 15th, but after that date he was not heard. The clover, in which the nest was probably placed, had been cut and possibly the home had been destroyed. It is to be hoped that their

* *Petrochelidon lunifrons.*

visit will be repeated next year. It can hardly be that they will not return to London, as they have always come so near us before that we have for years been on the point of having them with us in the breeding season.—W. E. SAUNDERS, London, Ont.

KEEN SIGHT OF BIRDS—On May 23rd 1894, I was an eye-witness of a little scene in the marsh at Rondeau that impressed me with the extreme care that wild things have to take of themselves. I had shot a Dowitcher, *Macrorhamphus griseus*, and one or two common birds, and wishing to skin them I approached a patch of semi floating rushes, mud, and debris to hold the canoe while I did so. I saw on the other side of the moss a Redbacked Sandpiper, (*Tringa alpina pacifica* and was rather surprised that he did not fly when I came near, but he was tame, and I set to work. For probably an hour he spent his time within from 10 to 30 feet from me, pruning and feeding. He worked with little dabbles of his bill in quite a peculiar way unlike anything I had previously seen. Once, when I glanced at him I saw him stop as though afraid of me—he looked steadily, and shrank down flat on the ground where he lay perfectly still.

I looked carefully for a hawk or gull but could see none; yet he stlll remained prone. At last after perhaps half a minute, he turned his head and seemed to be looking over to the northeast. On turning that way I saw against the cloud, an eagle still approaching, flying away up so far that without the assistance of the cloud I could not have found him; but the Sandpiper saw him quickly and prepared for business.

After the eagle had passed, the sandpiper arose and continued his repast, keeping, no doubt, a keen eye for the next intruder. As all this occurred within fifteen feet of where I sat, and the bird took merely the slightest notice of my motions it shewed how much less dread a bird has of a man than of a bird of prey. Before leaving the spot, I experimented with the bird to see that he was not wounded, and it took a good deal to make him fly, and when he flew it was only for a few feet when he settled and fairly defied me to scare him again.

W. E. SAUNDERS, London, Ont.

The Scientific African.—The *Scientific African* is a new monthly journal which will contain popular scientific articles on South African Animals, Plants, Rocks, and Minerals, containing not only accurate and illustrated descriptions, but also the habits, uses, and occurrences of them in South Africa and elsewhere.

All the industries of South Africa, in the Colony, Transvaal, Free State, Rhodesia, etc., will be described, also the workings of Mines and Collieries, Bridges, Harbour Works, and other engineering matters by which the wealth of South Africa is being enhanced.

All the latest news in the scientific world will be recorded, and the columns of the paper will be open to the discussion of scientific matters that interest and concern all classes in South Africa.

The *Scientific African* is to be published monthly and will appear simultaneously at Cape Town and Johannesburg, on the 1st Nov. 1895

NOTES ON SOME FOSSILS FROM THE TRENTON OF HIGHGATE SPRINGS VERMONT NEAR THE CANADIAN BOUNDARY LINE.

By HENRY M. AMI.

In the Spring of 1893, in Company with Dr. R. W. Ells of the Geological Survey of Canada, I had occasion to examine the fossiliferous rocks occurring in that most interesting and classic region about the east shores of Missisquoi Bay, both north and south of the international boundary line.

The geological structure of this district had been carefully studied and described by the late Sir William Logan and the late Mr. E. Billings and further contributions to the geological history of this district were published in 1831 by Prof. Jules Marcou* and later by Prof. C. H. Hitchcock in an early number of the Bull. Amer. Museum of Natural History, New York City.

On page 855 of the "Geology of Canada," Montreal, 1863, fig. 441—Sir William Logan gives a "section at Highgate Springs, Vermont" indicating clearly the various anticlinal folds and other flexures and faults of that locality. The relation of the Utica, Trenton, Bird's Eye and Black River, and Chazy formations to one another are therein indicated and described whilst the fossils which characterise the formations are mentioned in the text.

It is not my purpose in this paper to discuss the various problems which centre around the "Quebec Group" and "Taconic" controversies at this point nor yet to combat or assist in proving the theory of "colonies" of Barrande supported by Marcou, but simply to give a list of the species of fossils collected by Dr. Ells and myself at Highgate Springs from the limbs of the denuded Franklin House anticline and flexures of the Trenton formation.

*Bulletin de la Soc. Géol. de France, Extrait, Paris, 1881.

LIST OF GENERA AND SPECIES OF FOSSILS FROM THE TRENTON OF HIGHGATE SPRINGS, VT.

ECHINODERMATA.

2. Crinoidal columns and fragments, too imperfect for identification.

BRYOZOA.

2. Prasopora Selwyni, Nicholson. This is the most common Trenton massive or hemispheric bryozoary; usually referred to this species as described by Nicholson in his "Pal. Corals, Monticulipora," and called Favosites lycopodites by, Vanuxem, and by other authors: Stenopora petropolitana Pander, or Stenopora lycoperdon, Say.

3. 4. 5. Several branching forms of Monticuliporidæ requiring micro-sections before identification.

BRACHIOPODA.

6. Plectambonites sericea Sowerby.
7. Dalmanella testudinaria, Dalman.
8. Orthis tricenaria, Conrad. A small variety of this species.
9. Dinorthis pectinella, Emmons.
10. " sp., cf. O. Meeki, Hall.
11. Strophomenoid shell resembling Strophomena incurvata, Shepard sp.

(Streptorhynchus fililextum, Hall.

PTEROPODA.

12. Conularia Trentonensis, Hall. A very large and tolerably fine example of this characteristic species.

GASTEROPODA.

23. Bellerophon bilobatus, Sowerby.

CEPHALAPODA.

14. Orthoceras bilineatum, Hall.
15. " sp. without annulations but showing longitudinal flutings and finer lines parallel to the longer axis of the shell.

TRILOBITA.

16. Proëtus sp. cf. P. parviusculus, Hall.
17. Calymene senaria, Conrad.
18. Asaphus megistos, Locke, (Isotelus gigas, DeKay).
19. Trinucleus concentricus, Eaton. Numerous examples of this species which present the same characters as those of the Trenton limestone of Montreal Island, Montmorency Falls and other typical localities in the Province of Quebec.
20. Harpes Ottawaënsis, Billings. A fine example of this rare but beautiful species occurs in the collection.

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NOTES ON THE FLORA OF ONTARIO.

BY JOHN MACOUN, M. A., F. L. S.

II

NOTES ON THE SPECIES OF RANUNCULACEÆ OCCURRING IN ONTARIO OR WESTERN QUEBEC.

Within the above limits we have fifteen genera and forty-four species. Many of these occur under diverse conditions and in peculiar habitats and are seldom observed except by botanical collectors. It is the purpose of these notes to enumerate them all and in this way enable members of the Club and others to look out for them when opportunity serves.

The genus *Clematis* has with us two representatives which are very unlike in appearance and habit. The more common species is *C. Virginiana* which grows along all our rivers and brooks and climbs over alders and other bushes where its fruits of long-tailed achenes make it a prominent object in the autumn. In July and August its greenish white flowers are quite attractive and when carefully examined it will be found that the staminate one is the more beautiful as the filaments of the numerous stamens really make up the flowers.

The *Atragene*, (*C. verticillaris*) is rather rare in the settled parts of the province but on the rocky slopes of the Laurentide hills it is not uncommon and when seen is not easily forgotten, its violet sepals, from one to two inches long, being seen early in the season when flowers are more attractive than they are later. Kingsmere mountain is the nearest station to Ottawa.

The genus Anemone is represented by six species though two of them do not occur in the settled parts of the area under consideration but have their homes along Lake Superior and northward.

The Small-flowered Anemone, (*A. parviflora*, Michx.), is found in the crevices of rocks around Lake Superior and will very likely be detected both westward and northward in the province, as well as at the sources of the Ottawa and Gatineau rivers. This species seldom grows more than six inches high and has a *single white* flower.

The other rare species, *A. multifida*, Poir., has been collected at Pic River, Lake Superior and it, too, may be looked for both northward and westward. It is easily distinguished from the preceding by its dull crimson to yellowish-white flowers, deeply cut leaves and one to three flowered stems.

Two species *A. cylindrica*, Gray, and *A. Virginiana*, Linn., are rather common throughout the province and by collectors are very often mistaken for each other. The former, however, always grows on dry ground, whereas the latter, which is much less common, is found in rich moist soil, in fence corners and borders of woods. The easiest way to distinguish these species is by the fruit, which in the former is cylindrical and an inch or more long and in the latter ovate or oblong; if young or in flower only, the involucral leaves on the stem in the first are from 3—9, while in the second they are from 2—3.

Canadian Anemone (*A. Canadensis*, Linn. or *A. dichotoma* Linn.) grows in river bottoms throughout the province. It is seldom found over a foot high and grows in masses in low meadows where its white sepals are very conspicuous in June. In fruit, this species is easily recognised, as its achenes are nearly smooth and gathered into a round head.

Our species of Wind Flower, *A. quinquefolia*, L. or *A. nemorosa*, as it is generally named is a graceful little plant found in rich moist woods throughout the province but quite local. The little stem terminated by a single flower is seldom over eight inches high and has a whorl of 3—5 leaflets immediately under the flower. The sepals vary from white to violet and blue. The four last-mentioned species are common in the Ottawa district.

Following the Anemones we have Hepatica represented by two forms now admitted as species. These are *H. triloba* and *H. acutiloba*, so well known to all, young or old, as "Mayflowers." The former

has round-lobed leaves and the latter acute-lobed ones and these constitute the chief point of separation unless the fruit be examined.

The next genus Anemonella includes only one species A. *thalictroides*, the *Thalictrum anemonoides* of Gray's Manual. This is a lovely little plant, growing in clumps from fascicled tubiform roots, and is well worthy of a place in our gardens. It is common in open woods, in rocky places and in fence corners from Toronto westward and southward in the Niagara Peninsula.

Following this is the genus *Thalictrum* with three species, two of which are quite common, the third being rather obscure may also be common but being seldom collected is considered rare. The commonest species is *T. dioicum* found in all rich woods throughout the province. In the woods around Ottawa this is a lovely thing in early spring. As its name indicates the stamens are on one plant and the pistils on another. The panicles in the male plant are greenish purple. The stamens have long drooping filaments and fuscous anthers which when grouped make prominent objects in the bare spring woods.

Another species *T. polygamum*, Muhl. *(T. Cornuti*, L.*)* is found in river bottoms and around springs and by brooks throughout the country. In the neighbourhood of Ottawa, especially along the Rideau River above Billings' Bridge, it grows into a large bushy plant over five feet high. It flowers late and is seldom collected with ripe seeds.

Our other species is *T. purpurascens*, which has much the same general appearance but does not grow so tall nor in as damp soil. The stem of *T. polygamum*, is mostly green and glabrous and the flowers white, while that of *T. purpurascens* is purplish and a little glandular, and the flowers are purple or rarely whitish. These two species should be collected in fruit and carefully preserved as it is necessary to work out the distribution of the latter. The only authentic locality in Ontario known to the writer is on Dunning's farm, near Drummondville, Niagara Falls. Dr. Burgess has collected it near London. The specimens collected along the Ottawa by Dr. Ami are doubtful as they are without fruit.

Our next genus is *Myosurus*, (Mousetail), represented by one species *M. minimus*, *L.* This is a very remarkable and inconspicuous little plant but most interesting withal. It is a very small annual with entire, linear leaves in a radical tuft, and simple one-flowered scapes. After flowering the carpel-spike becomes elongated an inch or two which gives the name *Mousetail*. The only recorded localities in Ontario are in the vicinity of Belleville where it was found many years ago in damp places subject to overflow, on limestone shingle west of Albert College and at the Ferry House in Prince Edward County opposite Belleville.

Following this is the large genus *Ranunculus* which is represented by nineteen species, three of them introduced from Europe. This genus takes a multiplicity of forms and grows in all kinds of localities.

In our waters we have at least two species of White-flowered *Crowfoots*. One, *R. circinatus*, Sibth., is apparently uncommon in Ontario but very common in Manitoba and westward. The leaves of this species are sessile and are orbicular in outline and do not collapse in the least when taken from the water. We have this form from Patterson's Creek, Ottawa (Mr. Wm. Scott), and from Wingham (Mr. J. A. Morton).

The other, *R. aquatilis*, L. is very variable and takes many forms both in America and Europe. This species unlike *R. circinatus* has petioled leaves which collapse more or less when taken from the water. One form, var. *trichophyllus*, Gray, represents those specimens with rather short and slightly rigid leaves. We have this from Belleville, Owen Sound and Port Arthur. The second, var. *flaccidus*, *Pers.*, has much longer, soft and capillary dissected leaves all collapsing when withdrawn from the water. This is the deep water form and is no doubt plentiful in many of our streams, yet in our herbarium we have no Ontario specimens.

R. Cymbalaria, Pursh, is a low glabrous species that is at home along the sea coast or on the margin of brackish pools in the prairie region, but is occasionally found in mud along river margins where possibly there is saline ooze. Collected along the Ottawa at

Thurso, at Wingham, Ont., and at Fort William, near Port Arthur, Lake Superior.

The next is a water species with bright yellow flowers, *R. multifidus*, so named from its very much dissected leaves. Three forms were formerly included under this species but a better knowledge of their characters has been obtained and they are now easily separated. This species is always found in slow-flowing or stagnant water and when flowering has floating elongated fistulous stems and showy yellow flowers.

The var. *terrestris*, Gray, is a series of shallow water or wet soil forms which creep, rooting in the mud, with shorter stems and emersed coarsely dissected leaves and flowers and fruit smaller. Both the above are general throughout the province but seldom collected. This form is abundant in Malloch's Bay near the C. P. R. station, Ottawa.

A very peculiar species, *R. Lapponicus*, was described, as *Anemone nudicaulis* by Dr. Gray (see Manual, Page 38) from imperfect specimens, which were without flowers. Prior to that time it had been collected in a peat bog where Port Arthur now stands by the Rev. J. K. McMorine and in 1884 in peat bogs, Nipigon river by the writer.

A small and interesting species, *R. Flammula*, L. var. *reptans*, E. Meyer, is found creeping amongst gravel in, or close to, the water on the shores of all lakes and large streams throughout the country. It may be easily known by its creeping habit, linear or lanceolate leaves and small yellow flowers. Very common at Paugan Falls on the Gatineau.

Following this little species is a tall robust one, *R. ambigens*, Watson—nearly two feet high, rising from a decumbent base. Its leaves are lanceolate, acute, generally serrulate, 3 to 4 inches long and from one fourth to half an inch wide. This species has been gathered near Port Colborne and should be looked for in the marshy country on the Welland Canal.

Our next species, *R. rhomboideus*, Goldie, has had a variety of names as it begins to flower when hardly an inch above the ground, just as the snow disappears and continues in bloom for two months. This is a

common species in central and western Ontario, delighting in warm sandy soil.

A common species in rather damp woods and along old woodland roads is *R. abortivus* which might be taken for the above but it is quite smooth, more branching and has inconspicuous flowers. This has a var. *micranthus*, Gray—which may be found in our limits. It may be distinguished from the species by being more or less hairy, having a glabrous receptacle, or having some or most of its radical leaves three-parted.

An annual species--*R. sceleratus*, L. closely related to *R. abortivus* but with dissected leaves and succulent stems is a common species in boggy places or in the mud of ditches in many parts of the province but more especially west of Kingston. It has been found at Borthwick's Springs in the vicinity of Ottawa.

Another woodland species—*R. recurvatus*, Poir.—has no relatives on this side of the continent and being found in all rich woods is a common species. Easily distinguished by its reflexed sepals and petals, and in fruit by its round head and the long recurved beaks of the carpels.

Following this are two introduced species—*R. acris* L. and *R. bulbosus*, L. The former is very common by roadsides and in old damp pastures while the latter is either very rare or seldom distinguished from *acris*. Only two characters are necessary to distinguish these species. The latter has a globose, solid, bulbous base or corm, the former has not this base: in the former the sepals are merely spreading, in the latter they are reflexed.

R. Pennsylvanicus L.—is common in boggy places amongst weeds and grass. It is seldom over a foot high but is stout, and branching and has small flowers with reflexed calyx lobes and an oblong or almost cylindrical head.

Now follows a group of five species that require careful examination in the field, and good fruiting specimens for the herbarium. When Part I of my Catalogue was published, we had little information regarding them, but now they are easily separated. *R. repens* L., remains as I had it, and my var. *hispidus* becomes *R. Macounii*, Britton., but is still retained in Gray's Manual as *R. hispidus*, Hook. (page 43.)

R. repens being an introduced species is always found in the settled parts of the country, generally by ditches or in boggy pastures. It is perennial, and creeps extensively, lies prostrate on the ground or nearly so, forming mats: its leaves are often spotted, and usually very hairy.

R. Macounii grows in boggy places usually amongst grass, is ascending or declined, seldom or never rooting at the joints, and is not perennial. Our most eastern specimens are from Lake Nipigon, but it is certain to be found farther east.

The two following species are included in the *R. fascicularis* of Gray's Manual (page 43), but are separated in Dr. Britton's Revision and in Vol. I, Part I of the Synoptical Flora of North America just published. The species are *R. hispidus*, Michx. (not Hook.), and *R. fascicularis*, Muhl. Both grow in woods and flower early, but the former prefers the drier ground. Both have large flowers but the former is much the taller, and has fibrous roots, and the pubescence of the lower parts is spreading, while in the latter the roots are tuberous-thickened or fusiform, and the pubescence of the lower part of the stems is appressed. We have the former from Wesley Park, Niagara Falls, which is the only known locality but the latter species extends from the Bay of Quinte westward.

Closely related to these is *R. septentrionalis*, Poir., which has a wide range in the province, and seems to claim the alluvium along our rivers and smaller streams for its habitat. We have specimens from Manotick and Casselman and westward. This species is stouter than either of the others, is often stoloniferous, has large yellow flowers, and is seldom very hairy. It may be taken for *R. Macounii*, but is easily separated by its fruit, which is rather gradually contracted into a long flat beak. In *Macounii* the beak is short and straight, and formed of the whole flat, subulate style.

Following *Ranunculus* is the genus *Caltha* with one species—*C. palustris*, L., the well known "Cowslip" of the people or the Marsh Marigold of the books. This species is found by the margins of rivers and brooks and in wet places everywhere. Its early and bright-yellow flowers make it an attractive object in spring.

Isopyrum is a genus of low perennials which is represented in the province by one species *I. biternatum*, Torr. and Gray. Our only record of it is from London where it was found by Mr. J. Dearness. In general appearance it resembles *Anemonella* but the fruit is a two to three seeded follicle, whereas in that genus it it is an achene.

Gold-thread, (*Coptis*) is represented by one species *C. trifolia*, Salisb.—which is found in cedar swamps and on hummocks in wet woods throughout the province. The yellow rootstocks and white star-like flowers amply distinguish it from all other swamp flowers.

The Columbine (*Aquilegia Canadensis*, L.) is one of our lovely spring flowers and is found in dry places amongst broken rocks in all parts of the country. It is a curious circumstance that all the native Columbines, and we have six. grow amongst the debris of broken rocks.

No native species of *Delphinium* grows in the province but one. *D. Consolida* L., the common Larkspur of the gardens is often found by roadsides on waste-heaps or as a weed in gardens, and another species less branching—*D. Ajacis*— has been found at Lake Scugog by Mr. W. Scott of the Normal School, Toronto. The pods are the best character by which to separate them. In the first the follicle is smooth and in the latter, pubescent.

Black Snake Root or Black Cohosh, (*Cimicifuga racemosa*, Nutt.) is a rare species and is only found in the southwestern part of the province extending from Galt to the Niagara peninsula. It is a tall plant with straight and stiff racemes of flowers often over a foot long. We have nothing else like it and once seen, its general appearance will not be forgotten.

The Baneberry (*Actæa*) has two representatives in our rich woodlands which are difficult to separate when in flower. These are *A. spicata*, *L. var. rubra*, Ait. and *A. alba* Mill. In general terms, one is said to have red berries and the other white but this is not a fact as each species has berries of both kinds. Both grow in damp woods in rich soil and both have white flowers and very little difference in the form of the raceme. In fruit, however, they differ widely no matter what the colour of the berries, the pedicels in *A. spicata*

are long and slender, those of *A. alba* are short and stout and almost as thick as the peduncle.

Yellowroot (*Hydrastis Canadensis*, L.), is only occasionally met with and may be considered very rare. It grows in rich soil in woods and has been collected at Prescott and from Niagara westward to London. Owing to its large peltate leaves it might be taken at first sight for small specimens of *Podophyllum* but the situation of the flower dispells the illusion. In spring it sends up a stem and a single long-petioled peltate leaf. The stem has two leaves near its summit, one of these is petioled, the other sessile, and from this leaf rises a short peduncled white flower, followed by a red fruit resembling a raspberry.

SOME ACCOUNT OF THE BUSHY-TAILED WOOD RAT OF BRITISH COLUMBIA (NEOTOMA CINEREA, ORD.)

By C. DEBLOIS GREEN, Osoyoos, B. C.

In the interior of British Columbia there lives a small animal which is more destructive and more annoying than any other animal pest I know. It is the Bushy-tailed Wood-rat or Bush-rat, an animal rather heavier than the Norway Rat and having a tail not unlike that of a Flying Squirrel but not so well developed or silky. The whiskers are very long and coarse, the colour of the body is gray, and the hair is finer and longer than that of the Norway rat.

Its natural home is in the mountains among rock slides and broken rocky hillsides and where possible it protects its hole by collecting cactus and storing them in quantities all around its home, probably to keep coyotes and other enemies at bay. So long as it contents itself with this kind of life, it is bearable, but when it finds that a cabin is in the neighbourhood, the rock slide is not good enough for it.

The first warning one has of the objectionable presence of this animal in a house is hearing a series of heavy blows struck on some board as with a quirt. This is done with the tail which is kept going when

ever this fiend is thinking of what deviltry it can be up to next ; it is evidently bent on finding a suitable place for a nest. That is the very first consideration, and it will probably choose a corner of the cellar or the attic. They will build their nest steadily for a week and make it of everything one would think utterly useless for the purpose. For instance, the first nest we discovered was made of old clothes as a foundation, plentifully mixed up with knives, forks and spoons, about a bushel of old corn cobs, three dried cow's tails, a few books and some lumps of mineral, quartz, etc, evidently this rat was a prospector. Having built their nest, which seems to be for living in as much as for rearing a family, they then proceed to make sleep at night utterly impossible for the inmates of the house. One would imagine that some large animal was making hay in the kitchen, bang ! and down goes the bread pan, then a tray,then thump, thump, thump, and over goes the stove —at least you think so—but it is only the stove pipe ; you sit up and throw a boot, and silence reigns for five minutes, by which time the boot is down in the cellar or up in the attic. At the end of that time one of the rats perhaps runs right across you face, and in striking at it you knock all the skin off your knuckles and then hear the same old thump, thump, thump, inside the wall.

The smell of this animal is vile, and very few cats will fight one ; those who do have a heavy contract in hand, for they are even stronger than they look,—or smell. A figure 4 trap, with a weight of about 60 pounds (not less ! ! !), will hold a Bush-rat down. There are only two baits that are sure, one is dried apple, but better by far is a bait of a looking glass or a tin toy of some sort. Even the cut-out top of a milk tin makes a good bait, while a silver spoon is simply irrisistible, as they seem to think that the nest always needs a little more ornamenting. These rats are not so destructive in what they eat as in what they carry off, and the only case in which I have heard of one being useful, was that of a man who had lost a twenty dollar gold piece in his barn ; he knew that he had lost it somewhere in the stock yard, either in the stable, pigstye or barn, and some weeks afterwards went out prospecting for 6 months, next winter he returned to his cabin, and lo ! the $20 piece was on the corner of the dining table ornamenting a Bush-rat's nest, together with

other things from the pigstye, and stable etc. which are carefully avoided by all but Esquimaux dogs and Bushy-tailed Wood-rats. Wood-rats object to being caught in the common spring traps, but I don't think it hurts them very much from the way in which they will drag a trap about with a ten pound weight attached to it and by another sign of their apparent insensibility to pain which has come under my notice.

I camped one stormy night forty miles from the nearest inhabited house, in a trapper's old deserted cabin; of course there was the inevitable rat to be considered and the first thing he did was to take my soap off the table and carry it off to his nest. I found it there and next day took it to the stream 100 yards away left it there for safety, but next day sure enough, there it was back again in the nest

Well, this Bush-rat gave us no rest at all. He was like a devil turned loose all night, and I sat on my blanket in the middle of the floor trying to shoot him by the light of a flickering candle with a Lee-Metford rifle. A friend was trying to sleep in a bunk in the hut. At last I got a shot and made sure that I had hit him, bnt I could not find his body, as he seemed to fall down a hole. Fifteen minutes later my friend cried out that he had him between his knees. As you may very well believe, I lost no time in squaring our account and was not surprised to find that my shot had cut off one front leg high up at the shoulder. Yet that rat for five minutes before his capture was racketing round over every thing just as though nothing was the matter with him.

Every trapper and prospector in the mountains has many and extraordinary stories to tell of the Bushy-tailed rats and I find no difficulty in believing all I am told but perhaps some of the stories would not go down in the east.

This year I had to leave my house for a few months and four Bush-rats got into it. The state of that house after a month with them for tenants was indescribable on my return

There were six four-gallon coal oil cans full of cactus taken out of the dining room; there were remains of hundreds of specimens of my butter-flies which had been left neatly packed away in paper envelopes scattered all over the floor, down in the cellar, up in the attic, in fact

everywhere ; there were four nests in the house, constructed of white blankets cut up to suit—while huckaback towels cut into cotton rags, curtains, books, carpets, clothes, cartridges, pictures, work-baskets, groceries, wheat, cutlery, children's toys, cactus, bones of deer, dried cow dung, dolls' tea-sets, about 100 empty tins and 5000 prunestones, carefully brought a distance of sixty yards from the rubbish hole. I have not enumerated half the things in those nests but only a few that occur to me. In conclusion, I may say that the Bushy-tailed rat evidently considers that he owns any house in which he takes up his abode ; for him any human intruder is the only part of the furniture to be avoided ; but if cornered and brought to bay, he will not avoid even man but will act on the defensive and die fighting like a tiger.

NOTES, REVIEWS AND COMMENTS.

Geology :—DAWSON, SIR WILLIAM.— *The animal nature of Eozoon*, Geological Magazine, Oct., Nov. and Dec. 1895. 17 pp. with eight illustrations.

This is a "review of the evidence for the animal nature of *Eozoon Canadense*." Few are the geological subjects which have attracted more attention or have been discussed more freely than the question as to the animal nature of Eozoon. The purport of the present paper is to correct "some misapprehensions" which as Sir William says "seem to have arisen in regard to points well established and which independently of any question as to the nature of Eozoön, belong to the certain data of geology." Protest is also made "against that mode of treating ancient fossils which regards the most obscured or defaced specimens as typical." This contribution is divided into three parts :—

1. Historical and stratigraphical. 2. Petrographical and chemical. 3. Structural and Biological.

In reviewing the evidence adduced during the last thirty seven years Sir William says: "I confess that in the intervening time I have seen no good reason to induce me to doubt the essential validity of the work

embodied in the paper entitled, "On the Occurrence of Organic Remains in the Laurentian Rocks of Canada," a paper published conjointly, but prepared independently by Sir William Logan, Dr T. Sterry Hunt and Principal (now Sir William) Dawson.

After pointing out the latest views held on the lowest Laurentian by Dr. G. M. Dawson, Dr. Ells and Dr. F. D. Adams, Sir William summarises the facts and states that "in the case of the Grenville limestone" we have "to deal with a formation which indicates that in the early period to which it belongs regular sedimentation was already in full operation."

Sir William then describes the mineralization of *Eozoon* and meets the objections raised by Moebius "that the canal-systems of *Eozoon* and its tubes present no regularity, " by alledging that "good specimens and decalcified specimens are required to understand the arrangement" of these tubes and canal systems.

Dr. Carpenter's views regarding the combined Rotaline and Nnmmuline characters of *Eozoon* are again quoted by Sir William as practically unassailable.—H. M. A.

Botany.—*Canadian Wild Flowers.* Painted and lithographed by Agnes Fitz-Gibbon (Mrs. Chamberlin). Fourth Edition, 1895.

This new edition of a beautiful and well known book which first appeared in 1869 will be welcomed by all lovers of Canadian wild flowers. It is rather remarkable that with the many lovely wild flowers we have in our Canadian woods there is no work, with the exception of the one under consideration and Mrs. Traill's "Plant Life in Canada," now out of print, where accurate figures and descriptions of the many charming denizens of our woods can be found. A noticeable feature of this work is that it is essentially Canadian, not only were the drawings all done from nature by the talented artist, but also the lithographing of the plates and their subsequent colouring by hand, an undertaking simply gigantic in its proportions. The title page and ten plates upon which groups of some of our more showy native flowering plants are displayed in a most tasteful and artistic manner, are by Mrs. Chamberlin, an honoured member of our Club. The literary part of

the work, in which all the plants figured are described in a delightful way, is by the well known Canadian authoress, Mrs. C. P. Traill, who, although now 94 years of age, still continues, unabated, her labour of love, collecting the floral treasures of the picturesque islands near her home in Rice Lake and Stony Lake, and charms her friends by writing delightful observations on her favourites.

The binding and printing of this new edition by William Briggs, of Toronto, are all that can be desired. The work is a well bound and handsome 4to. of 88 pages, and I think the only fault that will be found with it will be that it is all too short.

We trust that this edition may meet with so ready a sale that the authoresses will feel encouraged to issue a second and similar selection from Mrs. Chamberlin's large collection of water-colour paintings of the wild flowers of Ontario.—J. F.

Ornithology.—During the fall of 1895, the Editor of the OTTAWA NATURALIST had the good fortune to meet Mr W. A. Hickman, a most enthusiastic and ardent ornithologist as well as naturalist in the town of Pictou, Nova Scotia. Mr. Hickman's zeal can be more readily estimated when we take into consideration the fact that in the course of his preparation of the notes recording the migration, stay, dates when first and when last seen on bird-life in the Pictou district of Nova Scotia—he has walked the long distance of 2,600 miles and travelled 4,000 miles by steamer during the season of 1895.

In obtaining records of observations on bird life the year previous, 1894, Mr. Hickman travelled in all 3,500 miles. The number of birds seen, the time when first seen, when last seen, whether the bird breeds in the locality in question, together with interesting remarks on the scarcity or direction of migration, etc., form some of the questions which occupy his attention. To facilitate his observations, Mr. Hickman has a lovely yacht at his disposal, and is an expert rider on the bicycle.

We venture to hope that we may soon receive additional material for publication from Mr. Hickman on bird or animal life in Nova Scotia.

The following list of birds observed at Pictou for the first six months of 1895, gives an idea of the thoroughness in which Mr. Hickman does his work. This list has been submitted to our associate editor, Mr. A. G. Kingston, dept. of Ornithology, who has prepared the manuscript for the printer, and our best thanks are due to Mr. Hickman for this interesting contribution from the east.

LIST OF BIRDS OBSERVED AT PICTOU, NOVA SCOTIA, FROM FIRST OF JANUARY TO FIRST OF JULY, 1895.

By W. A. HICKMAN, Pictou, N.S.

SPECIES.	FIRST SEEN.	WHEN COMMON	LAST SEEN.	REMARKS.
Northern shrike, *Lanius borealis*	Jan. 9	... ..	Apr. 20	not common, northern migrant.
Arctic 3-toed woodpecker, *Picoides arcticus*	" 21	...	Jan. 21	rare northern migrant.
American golden-eye, *Glaucionetta clangula americana*.	Feb. 20	Mch. 10	May 7	very common n. and s. migrant.
Glaucous gull, *Larus glaucus*.	" 20	... ...	Feb. 20	rare n. migrant.
Canada goose, *Branta Canadensis*	Mch. 7	Mch 30	Apr. 20	very common n. and s. migrant.
Dusky duck, *Anas obscura*	" 10	Apr. 13	....	breeds, very common.
American scoter, *Oidemia americana*	" 18	" 13	..	common, s. migrant.
Buffle head, *Charitonetta albeola*	" 21	... ..		common, n. and s. migrant.
Whitewinged scoter, *Oidemia deglandii*	" 23	" 11	Apr. 26	common, n. and s. migrant.
Ivory gull, *Gavia alba*	" 23	....	Mch. 23	rare, n. migrant.
American surf duck, *Oidemia perspicillata*	" 23	Apr. 5	June 3	very common, n. and s. migrant.
Song sparrow. *Melospiza fasciata*	" 24	" 6	....	breeds, very common, n. and s. migrant.
Eider duck, *Somateria dresseri*	" 24	" 20	....	common. n. and s. migrant.
Brant, *Branta bernicla*	" 30	" 15	June 9	very common, n. and s. migrant.
Slate-coloured snowbird, *Junco hyemalis*	" 30	Mch. 30	......	breeds, s. migrant.
Shore lark, *Otocoris alpestris*..	Apr. 4	Apr. 8	Apr. 14	common, n. and s. migrant.
Common crossbill, *Loxia curvirostra minor*	" 5	. .	. .	not common, n. and s. migrant.
White-winged crossbill, *Loxia leucoptera*	" 5	. .	. .	rare, n. and s. migrant.

SPECIES.	FIRST SEEN.	WHEN COMMON	LAST SEEN.	REMARKS.
Red-breasted merganser, *Merganser serrator*	Apr. 6	Apr. 13	....	breeds, very common, s. migrant.
Snow lark-bunting, *Plectrophenax nivalis*	....	....	Apr. 6	common, n. migrant.
American robin, *Merula migratoria*	" 8	Apr. 14	....	breeds, very common.
Am. Herring gull, *Larus argentatus smithsonianus*.	" 8	" 18	....	" " "
Am. Scaup Duck, *Aythya marila nearctica*	" 10	....	Apr. 22	common, n. and s. migrant.
Pigeon hawk, *Falco Columbarius*	" 10	Apr. 2	....	breeds, common.
Cormorant, *Phalacrocorax carbo*	" 10	" 21	....	" "
Fox-coloured sparrow, *Passerella iliaca*	" 11	" 13	May 7	common, n. and s. migrant.
Marsh hawk, *Circus hudsonius*	" 11	" 19	....	breeds, common.
Rusty grackle, *Scoleophagus carolinus*	Apr. 12	Apr. 21	....	" very common.
Green-winged teal, *Anas carolinensis*	" 12	....	....	not common, n. and s. migrant.
Field sparrow, *Spizella pusilla.*	" 13	Apr. 27	....	breeds, very common.
Great blue heron, *Ardea herodias*	" 13	" 20	....	" " "
American Woodcock, *Philohela minor*	" 16	" 23	.....	" common.
Pine grosbeak, *Pinicola enucleator*	....	......	Apr. 16	very common, n. migrant.
Bronzed grackle, *Quiscalus quiscula æneus*	Apr. 19	May 1	....	breeds, very common.
Wilson snipe, *Gallinago delicata*	" 19	Apr. 20	....	" " "
Red-tailed buzzard, *Buteo borealis*	" 20	....	....	" not common.
Gannet, *Sula bassana*	" 20	....	....	not common.
White-bellied swallow, *Tachycineta bicolor*	" 20	Apr 28	....	breeds, very common.
Pied-billed grebe, *Podilymbus podiceps*	" 22	....	Apr. 22	n. and s. migrant, not common in spring.
Am. bittern, *Botaurus lentiginosus*	" 22	May 6	....	breeds, common.
Goosander, *Merganser americanus*	....	....	Apr. 22	very common, n. migrant.
Kingfisher, *Ceryle alcyon*	Apr. 24	" 1	....	breeds, very common.
Purple finch, *Carpodacus purpureus*	" 24	" 5	....	" " "
Savanna sparrow, *Ammodramus sandwichensis savanna*	" 25	....	......	" common.
Common tern, *Sterna hirundo.*	" 26	May 7	....	" very common.
Arctic tern, *S. paradisæa*	" 26	" 2	......	" common.
Golden-winged woodpecker, *Colaptes auratus*	" 26	Apr. 27	....	" very common.

SPECIES.	FIRST SEEN.	WHEN COMMON	LAST SEEN.	REMARKS.
Olive-backed thrush, *Turdus ustulatus swainsonii*	Apr. 26	Apr. 28	....	" " "
Swamp sparrow, *Melospiza georgiana*	" 26	....	....	" not common.
Great-northern diver, *Urinator imber*	" 27	May 11	....	" very common.
Yellow redpoll warbler, *Dendroica palmarum hypochrysea*	" 28	" 1	....	" " "
Long-tailed duck, *Changula hyemalis*	....	....	Apr. 28	very common, n. migrant.
Redpoll, *Acanthis linaria*	....	....	" 28	rare northern migrant.
White-throated sparrow, *Zonotrichia albicollis*	Apr. 29	May 4	....	breeds, very common.
Yellow-rumped warbler, *Dendroica coronata*	" 30	" 7	....	" " "
Solitary sandpiper, *Totanus solitarius*	May 1	" 4	....	" " "
Hermit thrush, *Turdus aonalaschkae pallasii*	" 1	" 5	....	" common.
Barn swallow, *Chelidon erythrogaster*	" 1	" 8	....	" "
Chipping sparrow, *Spizella socialis*	" 2	" 5	....	" very common.
Red-throated diver, *Urinator lumme*	" 3	May 20	May 30	very common, n. and s. migrant.
Spotted sandpiper, *Actitis macularia*	" 1	" 4	....	breeds, very common.
Humming bird, *Trochilus colubris*	" 7	" 21	....	breeds, very common, first appearance very early.
American coot, *Fulica americana*	" 8	....	....	breeds (?), not common.
Semipalmated plover, *Ægialitis semipalmata*	" 9	May 15	May 28	very common, n. and s. migrant.
Cliff swallow, *Petrochelidon lunifrons*	" 9	" 25	....	breeds, very common.
Sparrow hawk, *Falco sparverius*	" 9	....	....	" not common.
Yellow warbler, *Dendroica aestiva*	" 10	May 24	....	" very common.
Chimney swift, *Chaetura pelagica*	" 11	" 23	....	" common.
American osprey, *Pandion haliaetus carolinensis*	" 11	" 19	....	" "
Red-eyed viree, *Vireo olivaceus*	" 11	" 20	....	" very common.
Black-throated green warbler, *Dendroica virens*	" 12	" 20	....	" " "
King bird, *Tyrannus tyrannus*	" 12	" 22	....	" " "
Ruby-crowned kinglet, *Regulus calendula*	....	....	May 12	rare, n. migrant.

SPECIES.	FIRST SEEN.	WHEN COMMON	LAST SEEN.	REMARKS.
American goldfinch, *Spinus tristis*	May 13	May 24	....	breeds, very common.
Blue-winged teal, *Anas discors*	" 15	....	....	not common, n. and s. migrant.
Pintail duck, *Dafila acuta*	" 15	....	....	rare n. and s. migrant.
Leach's petrel, *Oceanodroma leucorhoa*	" 15	....	....	breeds, not common.
Least Sandpiper, *Tringa minutilla*	" 15	May 17	May 28	very common, n. and s. migrant.
Piping plover, *Ægialitis meloda*	" 15	" 24	....	breeds, very common.
Oven bird, *Seiurus aurocapillus*	" 17	" 26	....	" quite common.
Golden plover, *Charadrius dominicus*	" 17	....	May 17	rare, n. and s. migrant.
Black-bellied plover, *Charadrius squatarola*	" 17	....	" 17	not common, n. and s. migrant.
American redstart, *Setophaga ruticilla*	" 18	May 25	....	breeds, very common.
Wilson thrush, *Turdus fuscescens*	" 18	" 25	....	" " "
Bobolink, *Dolichonyx orizivorus*	" 18	" 20	....	" " "
Wood pewee, *Contopus virens.*	" 19	" 25	....	" common.
Bank swallow, *Clivicola riparia*	" 19	" 28	....	" very common.
Black and white warbler, *Mniotilta varia*	" 19	....	....	breeds (?), not common.
Hudsonian titmouse, *Parus hudsonicus*	....	....	May 20	very common, n. migrant.
Yellow and black warbler, *Dendroica maculosa*	May 22	May 25	....	breeds, very common.
Greater yellow-legs, *Totanus melanoleucus*	" 22	....	May 24	very common in autumn, n. and s. migrant.
Lesser yellow-legs, *Totanus flavipes*	" 22	....	" 24	very common in autumn, n. and s. migrant.
Little green-crested flycatcher, *Empidonax virescens*	" 22	May 30	....	breeds, common.
Golden-crowned kinglet, *Regulus satrapa*	....	....	May 22	very common, n. migrant.
Bay-breasted warbler, *Dendroica castanea*	May 23	....	....	breeds, not common.
Eskimo curlew, *Numenius borealis*	" 24	....	May 24	n. and s. migrant, common in autumn not, in spring.
Turnstone, *Arenaria interpres*	" 24	......	....	not common, n. and s. migrant.
Wood duck, *Aix sponsa*	" 25	....	....	breeds, rare.
Maryland yellowthroat, *Geothlypis trychas*	" 27	May 28	....	" very common.
Purple martin, *Progne subis.*	June 2	June 8	....	" bec'mg common.

SPECIES.	FIRST SEEN.	WHEN COMMON	LAST SEEN.	REMARKS.
Cedar waxwing, *Ampelis cedrorum*	June 5	June 11	....	" quite common.
Night hawk, *Chordeiles virginianus*	" 7	" 19	....	" very common
Black-billed cuckoo, *Coccyzus erythrophthalmus*	" 10	" 18	....	" common.
Louisiana water-thrush, *Seiurus motacilla*	" 12	" 26	....	" not common.
Warbling vireo, *Vireo gilvus*	" 20	....	....	" rare.
Worm-eating warbler, *Helmitherus vermivorus*	" 20	....	....	" rare.
Loggerhead shrike, *Lanius ludovicianus*	" 27	....	....	rare, s. migrant.
Pine linnet, *Spinus pinus*	....	....	....	generally common, not seen this spring.
Winter wren, *Troglodytes hyemalis*	....	....	....	sometimes seen in fall.
Great-black-backed gull, *Larus marinus*	....	....	....	resident, very common.
Canada grouse, *Dendragapus canadensis*	....	....	....	" becoming less common.
Ruffed grouse, *Bonasa umbellus*	....	....	....	" very common.
American goshawk, *Accipeter atricapillus*	....	....	....	" not common.
Barred owl, *Syrnium nebulosum*	....	....	....	" our commonest owl.
Acadian owl, *Nyctala acadica*	....	....	....	resident, rather rare.
Great-horned owl, Bubo *virginianus*	....	....	....	" very common.
Northern hairy woodpecker, *Dryobates villosus leucomelas*	....	....	....	" not common.
Hairy woodpecker, *Dryobates villosus*	....	....	....	" very common.
Downy woodpecker, *Dryobates pubesceus*	....	....	....	" " "
Pileated woodpecker, *Ceophlœus pileatus*	....	....	....	" rare.
Blue jay, *Cyanocitta cristata*	....	....	....	" very common.
Canada jay, *Perisoreus canadensis*	....	....	....	" " "
American Raven, *Corvus corax principalis*	....	....	....	" " "
American crow, *Corvus americanus*	....	....	....	" " "
European house sparrow, *Passer domesticus*	....	....	....	" " "
Brown Creeper, *Certhia familiaris americana*	....	....	....	" not common.
White-breasted nuthatch, *Sitta carolinensis*	....	....	....	" common.
Red-breasted nuthatch, *Sitta canadensis*	....	....	....	" very common.
Black-capped titmouse, *Parus atricapillus*	....	....	....	" " "

Zoology :—MERRIAM, C. HART.—*1. Revision of the American genera Blarina and Notiosorex. 2. The long-tailed shrews of the Eastern United States. 3. Synopsis of the American shrews* of the genus Sorex forming pt. No. 10 of "NORTH AMERICAN FAUNA," Dec. 1895.

The first and third papers are by our Corresponding member, Dr. C. Hart Merriam, and the second by Gilbert S. Miller, jr. Together, they contain 100 pages of letter press accompanied by twelve plates of illustrations. The history, nomenclature and descriptions of the genera and species of North American long-tailed and short-tailed shrews are given in the two first-named papers. Many of the species described or recorded are from Canada and these are noted for the sake of reference.

I. One Canadian Genus and Species of Short-Tailed Shrews.

1. *Blarina brevicauda*, Say, (Sorex talpoides, Gapper.) Vicinity of Lake Simcoe, Ontario. Rat Portage, Lake of the Woods, and Ottawa,Ont. are all given as Canadian localities, besides Digby,N.S.

II. Long-Tailed Shrews, from Canadian localities.

1. *Sorex Hoyi*, Baird. Belongs to the new sub-genus : Microsorex, Baird. Recorded from New Brunswick and Nova Scotia.

2. *Sorex palustric*, Richardson. Locality : between Hudson Bay and the Rocky Mts. precise loc., South Edmonton, Alberta. This species is referred to the sub-genus *Neosorex*, Baird.

3. *Sorex albibarbis*, (Cope.) Can. loc , Lac aux Sables, Quebec, and Nova Scotia.

4. *Sorex Richardsoni*, Bachman, Manitoba west to Alberta.

5. *Sorex fumeus* Miller, N. Sp. Nova Scotia, New Brunswick and west to Ontario and the great lakes.

6. *Sorex personatus*, Saint-Hilaire. The male specimens recorded came from South Edmonton, Alberta.

*III. Canadian species from the Synopsis of the American shrews of the genus Sorex.**

In this synopsis by Dr. Merriam the following species of Canadian shrews are recorded by that author and the synonymy is also given besides the exact locality and the synonymy is also given besides the exact locality were the specimens thus recorded were found or captured. It will be seen that some of the species here recorded also occur in Mr. Miller's previous list (see above), but they are given as described by Dr. Merriam with the precise localities whence they were obtained.

1. *Sorex personatus*, Saint Hilaire. Loc : *Brit. Columbia* : Glacier, Field, Cariboo Lake, near Kamloops, Sicamous Mount Baker. *Assa* :—Indian Head. *Alberta* :— Sth. Edmonton, St. Albert, Island Lake, Banff. Canmore. *Manitoba* :—Carberry. *Ontario* :—Rat Portage, Ottawa, Parry Sound, Sand Lake. *New Brunswick* :—St. John. *Quebec* :—Godbout.

2. *Sorex personatus Streatori*, (sub-species nov.)—*Brit. Columbia* : —Glacier. *Alberta* :—Sth. Edmonton. *Quebec* :—Godbout.

3. *Sorex Richardsoni*, Bachman. Recorded from four Canadian localities. *Alberta* :—Sth. Edmonton, St. Albert, Island Lake. *Assa.* :—Indian Head. *Saskat.* :—Wingard. *Manitoba* :—Carberry.

4. *Sorex sphagnicola*, Coues. This is the so-called *Sorex Belli*, Dobson, and is interesting not only since the type came from Canada, near Ft. Liard, Brit. Columbia, but also because Dr. Dobson described the same species from a specimen collected by Dr. Bell from Hayes River, Hudson Bay, in 1885. Dr. Bell's specimen is said to have been the totem of an Indian chief, who, when he found out that he missed the totem, went on the war path. Precise locality :—Shamatawa River, Hayes R., Hudson Bay. Specimen in the Museum of the of the Geological Survey, Ottawa.

5. *Sorex vagrans*, Baird. Occurs in Brit. Columbia at Port Moody, Sumas, and on the Mt. Baker Range.

7. *Sorex Vancouverensis*, (Merriam) N. Sp. Type from Goldstream, Brit. Columbia, a species closely related to Sorex vagrans, Baird.

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*p. 57.

8. *Sorex obscurus*, Merriam, Abundant in Brit. Columbia. Occurs at the following localities :—Nelson, Ward, Field, Glacier, Golden, Kamloops (Cariboo Lake), Sicamous, Goldstream, V. I., Sumas, Comox, and Port Moody. In Alberta, at Henry House two specimens.

9. *Sorex Hoyi*, Baird. A Microsorex. Recorded from *Quebec* :—Godbout. *Nova Scotia* :—Digby. *Manitoba* :—Red River Settlement. *British Columbia* :—Stuart Lake.

Entomology.—THE CAMBRIDGE NATURAL HISTORY. Vol. V. Macmillan & Co., London and New York. 1895.

This is the second published volume (Vol. III treating of Mollusca having previously appeared) of a series now being issued under the able editorship of S. F. Harmer, M. A., Superintendent of the Cambridge Uuiversity Museum of Zoology, and A. E. Shipley, M. A., University lecturer on the Morphology of Invertebrates. The series of ten volumes when completed will constitute a work indispensable to the library of any one interested in Natural History, and will form an authoritative condensation of the present knowledge of animals in all branches. The present volume contains in the first place a twenty-four page account of the genus Peripatus, a curious slug-like creature, which "stands absolutely alone as a kind of half-way animal between the Arthropoda and Annelida." The species are few in number, but have an extended distribution occurring, in South Africa, Australia, New Zealand, South and Central America and the West Indies. This interesting and complete account of their structure, development and habits is by Adam Sedgwick, M. A., F. R. S., who had previously monagraphed the group. *(Quart. Journ. of Mic. Science, Vol. XXXVIII.)* The Myriapoda are next treated of by F.G. Sinclair, M.A., whose article covers some fifty pages, and is an admirable sketch of these many-legged creatures, which are generally looked upon distrustfully because of the dread inspired by the section known as centipedes, and our innate aversion to any crawling, wriggling creature that delights in darkness and concealment.

The remaining five hundred pages of the volume are devoted to a discussion of the Insects by D. Sharp, M. A., who will require another volume to complete his account of this most prolific of all the classes of animal life. Nearly one hundred pages are occupied by a very complete, although necessarily concise description of the anatomy, embryology and development of insects in general. This is followed by an outline of the classification and it is noted with pleasure that Dr. Sharp has not followed the propensity of some authors to divide the insects into a large number of orders, but has limited them to nine; viz. Aptera, Orthoptera, Neuroptera, Hymenoptera, Coleoptera, Lepidoptera, Diptera, Thysanoptera and Hemiptera. The first order contains Thysanura and Collembola, the little creatures, mostly found in damp localities, known as "springtails." The chapters dealing with the Orthoptera will attract the attention of many readers from the numerous interesting forms which are mentioned, whose great diversity of structure and ornamentation are so well depicted by beautiful illustrations of many of the remarkable genera which inhabit tropical regions. The Neuroptera, though not yielding such strangely developed and fantastic insects, are perhaps more interesting from their greater variety of habit, arising partly from the fact that so many of the species are aquatic in their early stages. This order also contains the familiar Termites, or so-called white ants, in which the social life has developed great variations in the forms and functions of different individuals and results in the construction of sometimes really wonderful erections. Each of these two extensive orders requires about one hundred and fifty pages for its exposition, and the remaining eighty pages treat of the Hymenoptera, (in part), the most interesting in many ways of all the orders of insects.

The portion of the order dealt with in this volume, includes the Sessiliventres (Saw-flies and Horn-tails) and the parasitic families of the Petiolata. Fine illustrations are given of several species which occur at Ottawa such as *Oryssus Sayi*, *Tremex columba*, *Thalessa lunator* and *Pelecinus polyturator*. All the illustrations throughout the volume are most excellent, and the figures, of which there are 371, have been in great measure drawn especially for the work, which is beautifully printed,

and neatly bound in cloth. It is a work which cannot be too highly recommended to the students desiring to have an accurate general knowledge of the animal kingdom, and the appearance of the next volume will be awaited with great interest. Dr. Sharp has pointed out that in Fig. 333, p. 490, *f* is called a division of the metanotum, whereas it belongs to the mesonotum. This error in writing the description of the figure will be corrected in the next volume: which will commence with the aculeate hymenoptera. —W. HAGUE HARRINGTON.

LECTURE COURSE.

Judging by the attendance at the lectures this winter the Councils of both societies have reason to congratulate themselves. Owing to circumstances over which the Societies had no control the lecture which was to have been delivered by the Hon. Dr. Montague, M. P. &c. was indefinitely postponed.

Extinct Monsters.—On the 23rd of January Dr. H. M. Ami of the Geological Survey Department gave a very interesting and instructive lecture on "Extinct Monsters." The material with which Dr. Ami illustrated his lecture consisted of a series of very carefully prepared lantern slides which he had obtained in Europe last summer, together with others specially prepared for himself in Ottawa from works bearing on the subject. Upwards of sixty magnificent lantern slides were thrown on the screen by means of an excellent oxy-hydrogen lantern, skilfully handled by Mr. Dunn of the Inland Revenue Department, Ottawa. These views illustrated the works of Cuvier, Sir Richard Owen Marsh, Cope, Huxley and others.

The most interesting and best known Amphibia, Reptilia, Dinosauria, extinct birds, Mammalia (including fossil elephants and horses), the sea-cow, and a large number of the most recently discovered specimens were described and shown to a large and appreciative audience.

Labrador.—On the 30th. of January Mr. A. P. Low of the same department gave a most graphic and charming description of his explorations in the Labrador peninsula. The various routes traversed, the character of the country, the trees, the inhabitants, the mineral resources of that region were all presented in such a manner as to elicit profound attention and frequent applause. Mr. Low's lecture was illustrated with numerous views of that little known yet very interesting Peninsula.

A very animated discussion followed the reading of this paper in which Dr. Selwyn, Dr. Thorburn, Prof. Macoun, Dr. Sandford Fleming, Mr. Tyrrell, Dr. Wicksteed and Mr. Anthony McGill took part.

Announcement.—The lectures for February under the joint auspices of the Club and of the Ottawa Literary and Scientific Society will be held in the Normal School as follows.

February 6th.—Dr. T. J. W. Burgess, of the Royal Society of Canada, Montreal, will lecture on: "How to study Botany."

February 20th.—Dr. F. D. Adams of McGill University, Montreal, will illustrate and describe "Pompeii." Dr. Adams has with him a very interesting series of lantern slides to illustrate that ancient city where such elaborate excavations have been carried on in recent years.

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NOTES ON THE STUDY OF BOTANY.

By T. J. W. BURGESS, M. D., F. R. S. C. &c. (Montreal, Que.)

Read before the Ottawa Field-Naturalists' Club, Ottawa, 6th February, 1896.

Mr. President, Ladies and Gentlemen:—

The highest and most important object of all human science should be mental improvement, and the study of natural history, in particular field-work, when properly pursued, is assuredly adapted to strengthen, discipline, and develop the mental powers. It robs the mind of contracted ideas, induces us to take close as well as comprehensive views of objects, and teaches us to argue from facts, not from fancies. Though the study of nature in any of her forms is calculated to bring about these results, none of the natural sciences is as good for beginners as botany, the materials being everywhere abundant and inexpensive. To the average student, plants, possessing life, are more interesting than minerals, while animals, though affording the most striking marks of designing wisdom, cannot be dissected and examined without painful emotions.

One of the most apparent of the many advantages to be gained by the study of botany is that it systematizes the mind, by imprinting on it and establishing habits of order and exactness. It thus gives all the benefits of mathematics or logic without the drudgery which debars so many from pursuing the study of these sciences. System is essential not only in science, but in conducting any kind of business and in the most trivial affairs of every-day life; thus, the very logical and systematic arrangement prevailing in botanical science cannot but induce in the mind a habit and love of order, which, when once established, will operate in even the minutest concerns. The methodical habits of

thought, by which alone plants can be properly examined, must necessarily be inculcated, and will prove invaluable in any vocation of life. Nor is it essential that the study (to be of use as a training for the mind) should be carried to any great length—we cannot all hope to be Darwins, Grays or Macouns—the elements of the science alone are sufficient as a means for the practice of this training to habits of methodical thought.

The taking of notes in a neat and systematic way, by which alone the results of examinations and discoveries can be recorded in a manner ready for reference, begets a concise style and an accurate use of exact words; while in the very collecting of material to form an herbarium, the faculty of observation is cultivated and developed, and the power to discriminate between species, thus to appreciate minute differences is obtained. Most important of all things to the botanist are these faculties of observation and comparison. Many persons have a natural acuteness in perceiving details of structure and in generalizing results, while others are very obtuse in such respects. Yet, in all, these powers can be cultivated and strengthened, and herein lies one of the great educational uses of botany, that it trains us to see and to think.

But in addition to the direct benefits to be gained by the study of botany, there are others of a more general nature, and man's great aim in life being the pursuit of happiness, I would place first the added pleasure it gives to life. To one not trained to an inquisitive appreciation of Dame Nature how comparatively few are the beauties she displays.

> "A primrose by the river's brim
> A yellow primrose is to him,
> And it is nothing more."

Very different is it when he has the slightest knowledge of botany Then, in even the humblest of the vegetable creation, he can note the structure, take cognizance of the relationship borne by the several parts to each other, see the marvellous way in which each organ is adapted to serve a certain end, and in all admire and do homage to that All Wise Being at whose creative fiat all things first were made.

Last but by no means least of the advantages to be mentioned is, that the pursuit of the science, leading to exercise in the open air, is

conducive to health and cheerfulness. Botany is not a sedentary study, which can be followed in the house, but one the love of which compels its devotees to seek their amusement out of doors, thus to breathe the pure air where the objects of their search are to be found; in the fields, along the winding brooks, on the mountain side, or in the cool depths of the forest. In every pursuit a certain amount of recreation and exercise is necessary for the maintenance of health, and walking is the means commonly employed to procure this. A walk taken merely as a duty is wearisome, but when indulged in with a definite and pleasant end in view it becomes delightful. As soon as one in his rambles begins to search for and collect any special class of objects he becomes interested, and marvels how he could formerly have been blind to so much that is curious and beautiful. To those who know anything of out-door life what a source of enjoyment it is to wander through the fields and woods. Each step brings some object of interest, or some new discovery: a flower not hitherto noticed, or some familiar one showing variation from the common form; a rare bird flitting from branch to branch; or some brilliantly colored insect pursuing its erratic flight.

During the past thirty years the methods of teaching botany have undergone a radical change. As formerly pursued the study consisted mainly in learning from some book, the names of the different kinds of roots, stems, leaves and flowers. If plants were obtainable the scholar was perhaps made to run superficially over a few of them, and by aid of an artificial key determine their names. The terms used were hard and unfamiliar and there were no specimens to illustrate the lessons. Was it any wonder then that pupils acquired a disgust for the science? Little or no field-work was attempted, and no thought was taken to promote habits of close observation, or to secure a knowledge of the mysteries of plant-life. By the new system of teaching, the special design of which is the training of pupils to fit them for original work, objects are studied before books, and the student is at once set to investigating and experimenting for himself.

To give you an idea of this modern method of teaching botany, I have made a short resumè of a paper on the subject by Professor Beal.

Before the first lesson each pupil is furnished with, or told where to procure, some specimen for study. If it is winter, and flowers or growing plants are not to be had, each is given a branch of a tree or shrub. The examination of these is made by the pupils themselves during the usual time for preparing lessons, and for the first recitation each tells what he has discovered about his specimen, which is not in sight. If there is time, each member of the class is allowed a chance to mention anything not named by any of the rest. If two members disagree on any point, they are requested to bring in, the next day, after further study, all the proofs they can to sustain their different conclusions. In learning the lesson, books are not used, nor are the pupils told what they can see for themselves. An effort is made to keep them working after something which they have not yet discovered. For a second lesson, the students review the first lesson,—report on a branch of a tree of another species which they have studied as before,—and notice any points of difference or of similarity. In like manner new branches are studied and new comparisons made. Time is not considered wasted in this. No real progress can be made till the pupils begin to learn to see; and to learn to see they must keep trying to form the habit from the very first; and to form the habit the study of specimens is made the main feature in the course of training. The use of technical names is not avoided, nor are these "thrust upon a student." They are learned as they are needed, a few at a time, from the teacher or a text-book. After from four to ten lessons on small branches, the following points, and many others, are brought out. Is there any definite proportion of active and dormant buds in any year? Where do branches appear? Is there any certain number of leaves in a year's growth, or any definite proportion between the length of the internodes? Is there any order as to what buds grow, and what remain dormant? etc., etc. The pupils are now ready for a book-lesson on buds, branches, and phyllotaxis, and will read it with interest and profit. In like manner any other topic, as roots, seeds, stamens, leaves or petals is first taken up by the study of specimens. Very little stress is placed on investigating a number of chapters in the definite order as given in a text-book. For example, it makes very little difference whether a pupil begins with the study of

petals or stamens, buds or roots, leaves or pistels ; but it is desirable after beginning any topic, not to abandon it until many of of the various forms have been thoroughly studied. After a day, two, three or more of study of the specimens pertaining to one topic, comes the study of the book. A young man of eighteen begins and pursues the same course as a child of ten, only he will progress faster and go deeper. As students advance, subjects for descriptive compositions are assigned them. Each pupil studies the living plants for himself and makes his own observations, experiments and notes, the only help afforded him being brief hints as to how to set to work intelligently. For instance,—one studies and writes upon the arrangement and development of the parts of the flower with reference to its self-fertilization or fertilization by birds, insects, wind or other means ; another the climbing of virginia-creeper ; another the times of opening and closing of flowers ; and so on *ad infinitum*. When completed the theses are read in the class-room. Throughout the academic year full three-fourths of the time is given to object lessons, books serving only for reference. But little time is occupied with lectures, short talks of ten or fifteen minutes being occasionally given. In the whole course there is kept constantly in view how best to prepare students to acquire information for themselves with readiness and accuracy, in other words, they are trained more than they are taught.

This, or some modification of it, is the system of teaching botany now most in repute, and wisely so. I agree fully with Prof. Beal that the great object should be to put students in the way of becoming independent and reliable observers and experimenters, and that the method of study pursued should be primarily objective, and based upon the actual examination of appropriate material. To my mind, however, a certain, though slight, amount of knowledge gained by the old system is necessary before much can be accomplished by the new, and I would prefer, if teaching, to first of all give my pupils some idea of what plants are, how they grow, the nature of their structure, and the number of their parts. This to be done in a short series (three or four) of familiar talks, made as simple as possible, with each point illustrated by drawings, models, dried specimens, or, best of all, freshly gathered plants. With

out some faint idea of plant life, to plunge a pupil headlong into the depths of the study, were to me like setting him to solve some abstruse mathematical problem prior to his learning the meaning of addition and subtraction. Mr. Beal, too, in his paper, whatever he may do in practice, makes no mention of a point which I deem of vital importance, viz., that every student in botany, from almost his very entry on the subject, should be urged to start and taught how to make an herbarium, or collection of plants, for himself. Field-work is of the greatest importance in promoting familiarity with habitats, and in solving most of the problems of plant life, and to induce pupils to engage actively in field-work there is nothing equal to starting them to form an herbarium, for in no other way can such an interest be excited. In my experience, young people can best be stimulated to take an interest in any branch of study by giving them something to *do* in connection with it.

But it is not alone in the excitement of an interest in the study of botany that the value of an herbarium lies. The ultimate end of any scientific study being the mastery of all that can be learned concerning it, the formation of a collection of plants in a manner most convenient for reference is a necessary part of the science of botany.

But enough has been said to give you an idea of the general principles on which botany is now usually taught in colleges and schools. Let me next devote myself to telling you what *I* consider the best way for *you* to enter on the study. The first step is to procure a text-book on structural botany. For choice I would name Gray's "Lessons in Botany." It is not too complicated and yet is extensive enough, except for advanced students who wish to devote themselves specially to the study. A work on systematic botany is also essential, and I know of none better than the "Manual of the Botany of the Northern United States," which covers our Canadian flora in great measure. I would advise any one purchasing to get the "Lessons" and "Manual" bound together. In this shape, the books are not only cheaper but more handy. We have in combination excellent works on both departments of Botany, Structural and Systematic, no small desideratum to the beginner, who, in naming plants by the latter, will

from time to time meet with unfamiliar terms, for the meaning of which he will require to refer to the former.

A text-book secured, comes what is generally looked upon as a rather dry part of the study, viz., the reading of it. Many words are met with which are strange and difficult to remember, but let me tell you that the labor of learning technical terms is usually much over-estimated. With practice they soon become familiar, while the discipline taught the mind in learning them is worth all it costs. There is no royal road to solving the problems of nature any more than there is to deciphering the mysteries of mathematics or metaphysics, but at each step the way becomes easier till at last what was a wearisome task becomes a pleasant and absorbing recreation. The so-called drudgery is greatly lessened if the reading be pursued in a proper manner, and especially if the reader has before him the proper material to illustrate the more important points in each topic as it is taken up. He who has some older botanical head to advise him what material to provide beforehand for each chapter, is greatly blessed,* but, whether he has specimens to examine or only the plates in his text book to guide him, I would strenuously advise him to make no effort to commit all the terms he meets to memory. Let him try to read slowly and understandingly, but let him bear in mind that the object of this primary reading, is only to get a general notion of plants and their parts, and to learn the meaning of a few of the most material technical terms, so as to be able to start collecting and naming plants for himself. Thus, in the first reading, he will gain an idea of the life-history of a plant, and discover that as a rule a miniature plantlet, the embryo, exists ready formed in the seed. If now this seed, say that of the maple, be placed in the ground and allowed to germinate, the miniature plantlet will soon be seen to develop in two opposite directions; downward into a root or descending axis, and upward into a stem or ascending axis. The stem as it reaches the surface of the ground will be seen to bear a pair of narrow green leaves, the seed-leaves or cotyledons. Soon between these seed-leaves will appear a little bud, which shoots upward into a second joint bearing another pair of leaves, which, however, differ in shape

from the first pair and resemble those of the maple as usually seen. Later, a third joint shoots up from the summit of the second, bearing a third pair of leaves, and so on until the plant likeness of the seed becomes a fully developed tree. The three organs, root, stem, and leaves, which exist in the embryo in a rudimentary state, are called the fundamental organs or organs of vegetation, because they have for their object the development and nutrition of the plant: while all the parts which succeed the leaves, such as the flower and its organs, are only modifications of them designed for a special purpose, and are called the organs of reproduction, since on them depends the increase of the plant in numbers, or the continuance of the species.

Proceeding onward with his reading the student will obtain some general knowledge of the various sorts and forms of these two sets of organs, and afterward will get an insight into the life of plants, and the mode in which they do the work of vegetation. He will discover that all plants possessing leaf-green (Chlorophyll) as the pigment which gives the green color to the leaves is called, possess also the power of assimilation, that is of making starch and similar organic compounds out of inorganic elements, such as water and carbonic acid: which transformation, briefly speaking, is thus effected. The plant through its roots, by the process known as osmose, takes in, dissolved in water, various compounds containing carbon, oxygen, hydrogen, nitrogen and other materials. The pressure exerted by the liquid as it comes into the roots, together with the attraction exerted by a constant process of evaporation from the leaves, causes the "sap," which is the plant food, to rise, and gives us what is known as the plant circulation. When, by this osmotic action, the sap finally reaches the leaves, it, in conjunction with carbonic acid derived from the air, is converted, in the chlorophyll grains under the influence of sunlight, into organic materials, which pass into a whitish granular liquid called protoplasm, and are used in "growth," that is in the building of new cells to form plant tissue. Assimilation takes place only in sunlight, but growth goes on most rapidly at night. In the former process oxygen is set free and given off through the leaf-pores or stomata, but in the latter, air is taken in through the stomata, and, as its oxygen is used up, carbonic acid gas is

given off. It will thus be seen, as tersely put by Mr. L. H. Bailey, Jr.—"*If the leaves are the lungs of the plant because they breathe, they are more emphatically the stomachs of the plant because they assimilate and digest.*"

It is now in order for the student to learn something of classification, as it is by this means he is enabled to analyze and recognize by name the plants with which he meets, thus to avail himself of all that has been recorded concerning them by botanists before him.

To the ordinary observer plants differ so much from one another that he can see no points of resemblance which could connect them naturally. For example, what likeness is there between the common strawberry and the mountain ash? Yet both belong to the rose family. Notwithstanding this great external dissimilarity, the botanist can readily point out in both, characters which at once stamp them as closely akin. The points which determine the relationship of plants are not confined to any one part of them: they may exist in the roots, leaves, flowers or fruits, but the natural system now in use aims to bring together those which most closely resemble each other in all these particulars, laying especial stress on the flowers and fruit. In this respect it differs from the Linnæan and all other artifical systems, which took up a certain set of organs and based kindredship on those alone.

The means by which a plant reproduces itself and is prevented from becoming extinct is evidently its most important and essential part, and it is upon this the fruit, that the vegetable kingdom is primarily divided, viz, into flowerless plants, such as ferns, mosses and fungi, and flowering plants, such as herbs, shrubs and trees. The former reproduce themselves by spores, which are commonly simple, minute cells and contain no embyro: the latter by seeds, which are embyro plantlets enclosed in an integument. Among flowering plants, increase in the diameter of the stem forms the first basis of division. There are two general methods in which this increase takes place. In the one case the woody tissue is scattered as separate threads throughout the whole stem, and the increase in diameter is by the interposition of new woody threads which stretch its surface; while in the other case,

the woody tissue is all collected so as to form a layer between a central cellular part, the pith, and an outer cellular part, the bark, the increase in diameter being by the addition of new layers of wood beneath the bark. The former class of plants, which includes our grasses, sedges and lilies, is called endogenous or "inside-growing;" while the latter, which includes all our northern trees and shrubs and most of our herbs, is known as exogenous or "outside-growing." In Canada, the endogens are all herbs with the single exception of Smilax, but in warm climates they are largely represented by the palms. It is not, however, only the manner of growth that separates these two great divisions of flowering plants: marked distinctions exist in the seeds, flowers and leaves. But I shall not weary you with these distinctions, nor by describing the principles upon which the exogens are again subdivided into polypetalæ, gamopetalæ, and apetalæ; neither will I inflict upon you the method of applying the system of classification to the naming of plants. All these you will find laid down in your structural botany under the heading "How to study plants." This I will say, however, that the analysis or naming of plants, tedious and difficult as it may at first seem, soon becomes very easy. After a few analyses the primary steps can be rapidly passed over, and I will guarantee that any one who will conscientiously study out twenty to twenty-five good examples will afterwards experience little difficulty in naming most of our flowering plants. Be not discouraged at the slow progress you will at first make; each successful analysis will facilitate the next, and very soon it will become so that when you have worked out one species of a genus you will be likely to know others when you see them, and even when plants of a different genus of the same family are met with, you will, ere long, generally be able to recognize their order at a glance from the family likeness. A capital practice for the beginner is to work out a few plants with whose names he is already familiar. Success in these attempts will naturally inspire confidence in the determination of plants previously unknown. . . . .

By his initial reading over of his text book the student has got some knowledge of plants and plant-life, as well as an insight into the manner in which their names are determined. He is like the race-horse to

which the jockey has just given a preliminary canter that he may "feel his legs" preparatory for his true task, the race, which lies before him. The knowledge he has gained is slight I grant you, but he is not quite in the dark. A foundation has been laid upon which it now becomes his duty to raise a creditable superstructure; a superstructure, the first step towards which should be the commencement of an herbarium which, however, should be subservient to, or a co-partner with, the highest aim in botanical science, the elucidation of the mysteries of plant-life. Laying such stress as I do on the formation of a collection as an aid to further study, let me for a little call your attention to the advantages to be derived from having one, and the best appliances and methods for accomplishing this.

The use of an herbarium is, in general terms, to have constantly on hand material for study in any class of plants, for, by soaking them in water, dried specimens can be studied almost as easily as fresh. In no other way can we see simultaneously specimens of neighboring species, different states of the same species, and specimens of a species from different localities; and some of the brightest theories on the distribution of plants have been worked out by the aid of the "hortus siccus" or herbarium. The nomenclature and classification of objects can be best acquired by the constant handling of them, and the price of a good herbarium is incessant vigilance in warding of the attacks of insect pests. But in this vigilance what a throng of pleasant memories is perpetually being called up: the time and the locality, the surroundings, and, if you were not alone when gathered, your companions. Each specimen represents so much information, and the very mention of its name will recall to mind associations connected with its study. These results from the possession of an herbarium have been so beautifully set forth by Professor Bailey of Brown University that I cannot refrain from quoting his words on the subject.

"In looking them over one sees not alone the specimens themselves, but the locality in which they were gathered. Many an incident of his life, the memory of which has long since become dormant will be re-awakened as by an enchanter's wand. He will thread the forest paths gay with flowers; he will pause in imagina-

tion for the nooning by some fern-laced spring; he will climb the mountain ravine where the blood-root and orchis bloom; or wander, full of speechless yearning, by the ocean shore. Not only do the natural scenes return thus vividly, but the faces of friends who enjoyed the occasion with him. He is once more seated, may be, by a little lake on the mountain, in a garden of alpine flowers. Cool streams flow by him, and he picks the tart fruit of the cowberry. The world lies mapped at his feet, and the infinite heaven is above him. He hears the merry jest and ringing laughter, and his heart becomes gay with the thought of those old-time rambles."

A collector's outfit, which will answer all ordinary purposes, is cheap and most of it can be got or made at home. It consists of a botanical box or vasculum; a plant press; a pocket lens; a trowel; a sharp pocket knife; and a note-book. The clothing worn in collecting should be strong, as one often has to make his way through a tangle of thorny bushes, and old, so that no nervousness at fear of spoiling it may be excited. For foot-wear, stout shoes are generally recommended, but I prefer the oldest and easiest pair I have. A pair with plenty of holes in them. One has occasionally to wade through a swamp where the water comes above the tops of any ordinary boots, and it is much better that it should run out freely as fast as it enters, than to have to sit down, take off and empty one's shoes,or continue to walk with the water sogging about in them.

With the vasculum you are all doubtless familiar. Any easily portable box will answer the purpose. Of late years, however, I have entirely abandoned its use, putting my specimens directly into the press, and carrying in my pocket an old newspaper or two, in which, previously dampening it, I loosely wrap up any plant that I wish to make special examination of.

Plant presses are of various kinds. The one that I commonly use, and which has stood me in good stead from Cape Breton to British Columbia, was given me by our mutual friend Dr. George Dawson when we were in the North-West together, away back in 1871. Though battered, as you see, it is useful as ever, and that after twenty-five years of honest service. It is made of quarter inch basswood strengthened by four cleats, and is 18 inches long by 11½ inches wide. The straps are provided with a cross piece, like a shawl strap, which prevents them becoming separated when the press is open, and also serves for a

handle to carry it by. Wire presses and those of lattice woodwork are highly recommended by some, the advantages claimed being lightness and a free escape of moisture. In wet weather, however, the ordinary form has the great merit of keeping one's paper dry. For an excursion the press should contain a good supply of specimen sheets and driers with one or two pieces of mill-board or thin deal, all of them a little smaller than the press. Any thin, cheap paper will answer for specimen sheets. What is known as printing paper is the kind I ordinarily use. For driers a special paper is manufactured, but it is expensive, and I substitute "filter paper" which is obtainable at most druggists. Blotting paper of any kind will do, and, if economy be an object, old newspapers can be made to serve. Some of the finest and most beautiful specimens I have ever seen were turned out from newspapers alone. The object is to have a medium that will quickly absorb moisture and as quickly part with it again. The mill-boards or deals are to keep apart the damp papers containing the plants and the dry unused ones. I also usually carry in my press a few sheets of cotton-batting to lay over ripe fruits, such as strawberries or raspberries, to prevent their receiving too much pressure and so getting crushed out of shape.

A pocket lens should always accompany the collector, and should not be of too high power, (an inch to an inch and a half focal distance.) A very powerful lens while magnifying greatly, inconveniently narrows the field of vision.

A stout table knife answers the purpose of a trowel, which is used for taking up plants by the root.

The note book is an object of prime importance, and should be of such a shape that it can be easily carried in the pocket. In this book are to be jotted down any observations one cannot trust to memory, e.g. the color of flowers, the height of plants, the character of the soil in which they grow, etc. Unless the collector takes field-notes he will run the risk of letting important observations escape him, and he cannot too soon learn to make them in a concise, systematic and legible way, never mixing up conjectures with actually observed facts. Everyone is

prone to get into a hurried way of making notes, under the idea that they are for his own use only, and that he will readily recollect any facts omitted at the time. This is a great mistake. Notes are not often required immediately, because every circumstance connected with the subject is fresh in the memory. But it sometimes happens that weeks, months or years after, in pursuing some branch of study, the exact facts then observed are required; and I know nothing more disappointing than, on turning to one's note-book, to find that at the time, trusting to memory, some of the details had been omitted.

In collecting, when a number of plants of a desired species are discovered, the first thing is to make a judicious selection. To be really valuable the specimens in a collection should be as perfect and characteristic as possible, so that anyone referring to it can learn full particulars about each species. A perfect specimen comprises all that is necessary for complete botanical investigation; leaves (both mature and immature, cauline and radical) flowers and fruit. Specimens can often be secured showing both flowers and fruit on the same plant, or fruit may be found on more advanced plants at the same time. If not in fruit, it must be collected in this condition later in the season. The same rule applies to the obtaining of specimens with different leaves, or leaves in different stages, and it may require several seasons to make a complete specimen. The plant should be so arranged as to be no larger when dried than can be readily mounted on the herbarium paper.

Of small herbs, the whole plant, root and all, should be taken, but in any case enough of the root should be collected to show whether the plant is annual, biennial or perennial. Large plants may be doubled into a V or N shape, and thick stems, roots or bulbs can be thinned down. In the case of very delicate plants, as many ferns, thin sheets of paper should be placed on both sides of the specimen, in which sheets it remains until perfectly dry. By this means the delicate leaves are prevented from doubling up in changing the driers.

Care should be taken to display the specimens neatly, showing, if possible, both sides of the leaves. In some cases it is easier to spread out the leaves and remove creases after a night's pressure has somewhat subdued their elasticity. Morning is the best time to collect most flowering plants, as many close their blossoms by noon, but those that open in the evening, vespertine flowers, should be gathered at that time.

The actual pressing and drying of specimens is done at home, either in the ordinary field press in which they were collected, or between a couple of pieces of inch board of the same size as the press. Weights make the best pressure, and a good weight is made of half a dozen bricks tied together with a cord strong enough to lift them by. Specimens should be put into the drying press as soon as possible after gathering, but often in returning from an excursion one is too tired to care for more labour, and I commonly leave mine in the field-press until next morning, nor do I find them suffer any harm from so doing. Herein lies one of the great advantages of collecting directly into the field-press instead of a vasculum. In drying, the thin sheets (specimen sheets) containing the plants are transferred into fresh driers, heated in the sunlight or by a stove, and remember always, *the hotter they are the better.* Be careful to place the specimens in such a way that one part of the bundle is not materially thicker than the other, by placing them on alternate sides, or putting in wads of paper if necessary. Plants dry best in small piles, and for dividing up a package if too large, or for separating the lots put into the drying press on different days, use thin deals like those taken out in collecting. Some very succulent plants, and others with rigid leaves, such as stone crops and pines, dry better if plunged for a moment into boiling water, ere being put into the drying press. Every day, or at first even twice a day, the plants in their specimen sheets are to be shifted into fresh hot driers, the moist ones taken off being spread out to dry in the sun or by a fire, that they may take their turn again at the next shifting. The more frequently the plants are changed the better will they retain their color. After the first three or four days the changes need only be made every other

day until the specimens are thoroughly dry and no longer moist or cold to the touch. The drying usually occupies from a week to ten days, but varies according to the succulency of the plants, the state of the weather, the frequency of the changes, and the degree of heat of the driers. The most convenient place for changing plants, if it can be managed, is a table beside a good hot range or stove, the top of which is free for use. If a damp drier be laid flat on the hot metal, steam at once begins to rise from it, and the moment it ceases to do so the paper is dry; leave it for a second until it becomes so hot as to be barely touchable with the naked hand, then lay it quickly on a specimen previously moved from the damp pile, and continue thus until the whole lot is changed. This plan is invaluable when driers are scarce, as sometimes happens on a botanizing trip, for by it the same driers, no matter how wet, can be used again immediately. A plan adopted by myself and Professor Macoun a few years ago, while collecting in Nova Scotia, might be mentioned as worthy of remembrance should any of you ever be placed in similar circumstances. Though not to be recommended for common use, as the specimens fall short of those obtained by the ordinary method, yet, if so situated that an abundance of driers is not obtainable, or if the weather be so foggy and wet that they cannot be properly dried, it will be found of great practical value. On the trip referred to, a large number of specimens had been collected, but so bad was the weather from rain and sea fogs that there was great danger of losing them all. Under these circumstances the thought occured to take advantage of occasional glimpses of sunshine in the following way; each sheet of specimens was placed between two driers, which were spread in a single layer on the floor of an open balcony exposed to the sun. Pieces of board, logs, or bark placed in the sun would of course answer the same purpose as did the balcony. Small stones placed on the corners of the sheets prevented the wind disturbing them, and no pressure was used except the weight of the single drier them covering. An hour of good sunshine served to fully cure most plants. The plan, is only applicable to specimens previously somewhat wilted in the pressas the leaves of fresh or insufficiently wilted ones curled up in the absence of pressure.

A collector's work does not cease when his specimens are dried. Plants are subject to the attacks of insects and it is therefore necessary to poison them in some way. The best protection is corrosive sublimate dissolved in alchol, which is applied lightly to the specimens with a soft brush. It should be done as soon as the plants are dried, care being taken afterwards to leave them spread out until the alcohol has evaporated. The formula I used is:

Corrosive sublimate	1½	drachms.
Carbolic acid	1½	"
Alchol	12	ounces.

All the work hitherto done, the collecting, drying and poisoning, is but the preparation for the formation of an herbarium, the specimens in which should be fastened on half sheets of stiff white paper, either by slips of gummed paper or by glue applied to the backs of the specimens themselves For a few cents a supply of white gummed paper, sufficient to last for years, can be purchased at any printing establishment. A narrow slip of this is cut off, moistened with the tongue, and placed over the part of the plant to be fixed down. The advantage of this process over actually glueing the specimens to the paper is that, in case the plant has to be removed for examination or any other purpose, these slips can be easily lifted.

In mounting plants care must be exercised to keep the pile forming each genus as nearly level as possible, by scattering the specimens over the sheets instead of placing them all in the centre. If the plants are small put some at the top of a sheet, some at the bottom, some on the right side and some on the left: occasionally, in the case of large specimens, reversing them so as to have the thick stems and roots at the top. In no case should more than one species be put on the same sheet, but if small, two or more specimens of the same species may be so placed. The best size for mounting paper is what is known as the standard size, from its being the one used in the public herbaria of the United States. This size, 16½ x 11½ inches, experience has determined to be the best. My own sheets, I am sorry to say, are smaller, being only 15½x 10 inches, but my collection was started and had grown to such a size before the standard was adopted, that to change it all would

have entailed great labour and expense. I have therefore considered it advisable to continue as I began. The Linnæan herbarium is on paper of the common fools-cap type, but this is much too small.

The labels to be attached to the sheets vary according to taste, the points desirable of observance being clear type, neatness and simplicity. They should not be to large nor yet too small. When a specimen is given you the accompanying label should always be mounted with it. Some collectors attach their labels permanently with paste or by having them printed on gummed paper, but I prefer to merely fasten them lightly at the sides thus allowing their removal should it ever become necessary to transfer the specimen to another sheet. All the sheets containing plants of the same genus are placed in genus covers, which are full sheets of stout, colored paper. They should measure about a quarter of an inch more in width than the mounting sheets. The name of the genus is written at the bottom of the genus cover, or sets of genus labels can be purchased cheaply and one of these pasted on instead. The various genera are arranged under the order to which they belong and laid flat in large pigeon-hole compartments in a closed cabinet, or else placed in portfolios, which stand upright like books in a book-case. The herbarium is made complete by a list or catalogue of the plants it contains.

Having thus described the method of collecting and preserving specimens, let us briefly consider the next step in the study of botany, viz. excursions. The object of collecting excursions should be three-fold :

1st. To cultivate habits of observation and secure knowledge of habitats and the growing appearances of plants.

2nd. To gather specimens for the herbarium.

3rd. To secure material to work on during the study of structural botany.

Even in the winter season excursions should not be entirely abandoned. The true naturalist can always find something to admire, and much useful work can be done in observing the trunks, branches and buds of trees and shrubs. Winter is, however, the time pre-eminently fitted for herbarium work, preserving, mounting, labelling,

cataloguing, and, if the necessary appliances are obtainable, laboratory work with the microscope.

The best place to begin collecting is where you live. Be your abode where it may there are surely some plant rarities near it, and the first goal to struggle for is a through knowledge of the resources of your own vicinity. When you have made a special study of the plants there you may easily extend your researches. If on your excursions you can have the company of some older botanist so much the better, since from him you can get the names of the plants you gather and the prominent characters on which the naming is founded. I would, however, strongly advise you always to take home one or two unnamed specimens, on which to practice analysis, for it is only by such practice you can ever become so familiar with the orders as to be able to, at least pretty nearly, locate strange ones at a glance. The accumulation of a mass of unnamed plants is to be avoided, lest a pleasant task becomes a wearisome labour, inspiring only disgust. Make it a rule to get your specimens named as soon as possible. If you have no one near to whom you can show them, enter into correspondence with some botanist and arrange with him to name the packets you may send him from time to time. You need not fear that your letter asking the favor will be unanswered. The wonderful spirit of fellowship, comradeship if I may call it so, existing among scientists, and evinced by their willingness to lend a helping hand to even the humblest votary, is to me one of the greatest charms in scientific pursuits. But here a word of warning,—never send scraps of plants to be named, for though a good botanist can often identify them, it is unfair to ask him. His time is too valuable to be spent in guessing riddles. Courtesy also demands that in all correspondence the seeker after information should enclose stamps for return postage. In collecting a specimen for yourself, if it be at all rare, always, if possible, gather duplicates to be used in exchange. Under no consideration, however, obliterate a rare species from any locality, and do not even make its whereabouts known to any except true lovers of the science. There are vandals, who, through mere vanity, would not hesitate to destroy the last survivor of a species; nor would they do it only unthinkingly. From the duplicates

of the best things around you a large variety of plants can be got by exchange. and the pleasure and profit in making a collection is largely due to the intercourse thus brought about with those of kindred tastes. Nor is this confined to those in your own country; it is often necessary to have certain specimens from other regions, and you are thus brought into correspondence with scientists in all parts of the world. Let your specimens be well made, and never send away a poor one unless it be of something very rare. A man soon becomes known by his exchanges, and if his specimens are poor he is made the subject of much unpleasant criticism and will in time be avoided by all good collectors. Always preserve the choicest specimen collected for your own herbarium, but after this send the best you have to the first correspondent who asks for it. Keep even a fragment of any species not represented in your collection until you get a better, but of your duplicates destroy any too poor to send away. Do not hoard up duplicates. The man who studies science for science sake would sooner give away every specimen for nothing than allow them to remain buried like a miser's gold. Make sure that all plants you send are correctly named, and notify your correspondent whether they are poisoned or not. Never promise a plant unless you actually have it or are positively certain of being able to get it, and keep a catalogue of your duplicates that you may be prepared at all times to answer a brother collector who applies for anything.

The last stage in botanical study, and the one to which all the others should be stepping-stones, is the working out of some of the many unsolved problems of plant life by independent and intelligent observation and experiment. The breadth of the field for exploration by original observation is immense, as comparatively little is known of the laws governing many of the phenomena of plants. For example, little is known of the hosts of some of our parasitic plants, and in some cases it is even disputed whether certain plants, commonly considered such, are parasites at all; though all plants move more or less, we possess scanty knowledge of the nature of this movement in many of them, and still less of its object; we know that cross-fertilization is generally necessary for the production of perfect seed, but in many cases we do not know

the particular agents that perform the work; we are aware that cleistogene flowers produce pods far more fruitful than the ordinary blossoms, but we know almost nothing about the proportion of the kinds, or why a plant should be provided with two sets of blossoms. There are many other points just as vague, hints to which may be found in such works as Darwin's "*Climbing Plants*," Bailey's "*Talks Afield*," Prentiss' "*Mode of Distribution of Plants*," and Kerner's "*Flowers and their Unbidden Guests*": enough, however, has been said to show that the way to discoveries new to science is open to even the humblest votary. There is practically no limit to the papers that could be prepared by many of you for this or similar societies: papers both interesting and useful: papers of value to science: papers that I feel sure the "OTTAWA NATURALIST" would gladly find room for. In conclusion, I would say, that if within his means, and they are very cheap, no student of botany should neglect to take at least one of the periodicals devoted to the science. The "*Bulletin of the Torrey Botanical Club*," the "*Botanical Gazette*," and the "*American Naturalist*" are among the best. The first two are devoted entirely to botany, the last takes up other sciences as well. I take it for granted of course that all of you are already subscribers to your excellent local Natural History monthly.

If I have trespassed too much on your time, or wearied you with my effort to make plain to you some points on the study of botany, I pray you pardon me. Each of you who takes up this charming science will, I have no doubt, see modifications that you think might be advantageously made in the methods suggested. Should it be so, by all means adopt them. The method employed is of little importance provided only it brings about the great aim and end of the study, which is to learn to observe and compare. Do this honestly and you cannot fail to become lovers of nature, and, as lovers of nature, better and happier men and women, men and women in some degree approaching the illustrious scientist of whom was sung:—

> "And Nature, the old nurse, took
> The child upon her knee,
> Saying: 'Here is a story-book
> Thy Father has written for thee.'

'Come, wander with me,' she said,
  'Into regions yet untrod;
And read what is still unread
  In the manuscripts of God.'

And he wandered away and away
  With Nature, the dear old nurse,
Who sang to him night and day
  The rhymes of the universe.

And whenever the way seemed long,
  Or his heart began to fail,
She would sing a more wonderful song,
  Or tell a more marvellous tale."

GENERAL INDEX

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OTTAWA NATURALIST, VOL. IX., 1895-'96.

AND

Transactions of the Ottawa Field-Naturalists' Club, Vol. XI.

ERRATA:

Page 23, line 2; for *Americana*, read: *Aucuparia*.

" 175, " 13; " *Bulimus*, " *Bulinus*.

" 175, " 32; " 451, " 351.

" 175, " 32; " 1884, " 1885.

" 176, " 4; " 95, " 65.

" 215, " 19; " 1893, " 1883.

" 178, Heading of column 5, for Wheeler, read Willing.